BenQ Materials Corp

TOUCHING EVERY MOMENT
Powered by Materials Science
材料科學改變每一個醫療瞬間

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From Materials Science to Healthcare: The Beginning of “Touching Every Moment”

From materials innovation to healthcare solutions, BenQ Materials has dedicated more than two decades to advancing the possibilities of technology. As materials science increasingly responds to healthcare needs, each innovation represents more than a technological breakthrough. It reflects a long-term commitment to improving health, enhancing care, and supporting lives.

Why would a materials company enter the healthcare industry? It is a question BenQ Materials has encountered almost every time it has ventured into a new field.

From optical discs, polarizers, and optical films to battery separators and waterproof, breathable performance textile —and now a diverse portfolio spanning Clinical Solutions, Advanced Medical and Hygiene Solutions, Sterilization Barrier Solutions, vision care, skin wellnesss—the Company's journey may appear to be one of continual diversification. Yet, viewed through the lens of its founding purpose, BenQ Materials has in fact been following the same path all along.

Innovation Begins with Solving Problems

BenQ Materials traces its origins to Daxon Technology Inc., founded in 1998. Its first product was the optical disc. Even then, however, the company never saw itself simply as a disc manufacturer. From the beginning, it was positioned as a technology company built on expertise in materials chemistry. Over the years, BenQ Materials has continued to deepen its capabilities in polymer materials, film formation, stretching, coating, lamination, and precision manufacturing. By combining and extending these technology platforms, the company has gradually developed the ability to apply materials expertise across multiple industries.

The transition from optical discs to polarizers marked one important transformation. The expansion from display materials into energy materials and healthcare applications represented another. Yet, behind every transformation, one thing has remained unchanged: a commitment to exploring the possibilities of materials science.

We believe the value of a core technology is not defined by the industry in which it is applied, but by its ability to create new possibilities.

The same film-forming and stretching technologies can become polarizers in display panels or separators in lithium-ion batteries. They can be used to create waterproof and breathable performance textile or transformed into critical protective materials for medical products. The world of materials may seem microscopic, but it often determines a product's performance, reliability, and, ultimately, the value it creates.

From Industrial Applications to Health Impact

As its materials expertise continued to evolve, healthcare naturally emerged as an important direction for BenQ Materials' next stage of growth. In reality, healthcare was not a sudden diversification into a new field. Rather, it was the natural extension of capabilities built and refined over many years.

At the group level, the BenQ Qisda Group began investing in healthcare more than two decades ago, gradually building a comprehensive healthcare ecosystem spanning medical services, medical devices, consumables, and healthcare distribution channels. For BenQ Materials, however, the path was different. Rather than following the route taken by many electronics companies into medical devices, BenQ Materials chose to begin with what it knew best: materials science.

Today, the company has established five major healthcare technology application areas: Clinical Solutions, Advanced Medical and Hygiene Solutions, Sterilization

Barrier Solutions, Vision Care, and Skin Wellness.

While these products and markets may appear distinct, they are all built upon the same core capabilities.

From polymer material design, precision coating, and film-forming technologies to lamination and validation expertise, these capabilities continue to be applied and refined across industries. In doing so, BenQ Materials has evolved from a materials supplier into a healthcare technology platform.

Because we have always believed that the true value of a material lies not in the material itself, but in the difference it ultimately makes in people's lives.

Building Trust Over Time

If innovation is what drives the electronics industry, trust is what defines the healthcare industry. This has been one of the most profound lessons BenQ Materials has learned through its healthcare journey.

Innovation can be achieved in a relatively short period of time. Trust, however, often takes years, or even decades, to earn. For a product to move from research and development into real-world clinical use, technological breakthroughs alone are not enough. It must also withstand regulatory review, quality validation, clinical application, and market scrutiny.

Over the years, BenQ Materials has continued to strengthen its capabilities across the entire value chain, from materials research and product design to precision manufacturing and quality assurance. The goal is to ensure that every innovation earns the confidence of both the market and the healthcare community.

To us, quality is not simply one step in the manufacturing process, it is the foundation upon which trust is built.

Any detail overlooked, no matter how small, has the potential to affect clinical outcomes. Conversely, every instance of consistent and reliable performance contributes to the accumulation of trust.

From the moment materials enter the factory to the moment a product reaches the hands of its user, every manufacturing step, every inspection, and every validation serves the same purpose: ensuring that the product performs exactly as intended when it matters most.

Every Moment of Care Gives Purpose to What We Do

The meaning behind “Touching Every Moment” is simple: every important moment deserves the support of better materials. It is more than a brand promise. It reflects how BenQ Materials understands the role of healthcare technology.

Whether it is the moment a patient faces pain and uncertainty, the moment a healthcare professional makes a critical clinical decision, the moment a wound begins to heal, or the moment someone returns to everyday life, materials science should be there in the background, quietly making a difference.

Looking ahead, BenQ Materials will continue to build on its foundation in materials science, combining precision manufacturing, rigorous quality validation, and global operational capabilities to create a more comprehensive healthcare technology platform. We do not innovate for the sake of technology itself. We innovate to bring meaningful solutions into clinical practice, integrate them into everyday life, and create value whenever care is needed.

Because we believe the ultimate purpose of technology is not simply to create products, but to improve people's lives. And every moment of care deserves the support of better materials.

“Touching Every Moment, Powered by Materials Science.” This is more than BenQ Materials' vision for healthcare, it is the direction that continues to guide us forward.

From Identifying Problems to Solving Them

From Diagnosis to Treatment: A Materials Revolution Reshaping Wound Care

Wound care may appear to be little more than dressing changes and bandaging, yet the factors that most influence healing are often hidden from view. From biofilm detection to home-based negative pressure wound therapy, advances in materials science are steadily transforming the way wounds are managed, enabling earlier intervention while minimizing disruption to patients' daily lives.

In recent years, wound care has evolved beyond simply selecting better dressings. The focus has increasingly shifted toward building more comprehensive and integrated care pathways. The Anscare Wound Biofilm Detection Kit and the SIMO Negative Pressure Wound Therapy System (SIMO NPWT), both developed by Anscare, address two of the most critical challenges in wound management: how to identify problems sooner and how to ensure treatment can continue effectively over time.

Only by Identifying the Problem Can Treatment Truly Begin

The challenge of chronic wounds extends far beyond delayed healing at the surface. For many patients, the greater difficulty lies in wounds that remain trapped in a prolonged inflammatory state, characterized by recurrent infections, increased exudate, and impaired tissue repair. The consequences affect not only quality of life but also place an ongoing burden on healthcare systems and caregivers.

Recent studies suggest that approximately 80% of chronic wounds are associated with biofilm formation. Once bacteria attach to the wound surface, they continuously secrete extracellular polymeric substances (EPS), gradually forming a protective biofilm structure. This biofilm not only impedes antibiotic penetration but also reduces the effectiveness of topical therapies and wound dressings. As a result, wounds can remain locked in a state of chronic inflammation, making biofilms one of the hidden factors behind many hard-to-heal wounds.

The greatest challenge, however, is that biofilms are often “invisible.” Traditionally, confirming their presence required collecting wound samples and sending them to a laboratory for culture—a process that often took two to three days before results became available. During this waiting period, clinicians frequently had to rely on experience when deciding whether additional debridement or antimicrobial intervention was necessary, increasing the risk of missing the optimal treatment window.

To address this clinical gap, Anscare collaborated with the Division of Plastic Surgery, Department of Surgery, National Taiwan University Hospital, and National Tsing Hua University to develop the Anscare Wound Biofilm Detection Kit. What once required several days can now be assessed at the bedside in as little as five to ten minutes. For healthcare professionals, the most significant benefit is not simply faster results; it is the ability to intervene earlier, enabling more informed and timely treatment decisions when they matter most.

From Research Breakthrough to Clinical Tool: The Real Challenge Has Only Begun

The most difficult part of innovation is often not making a breakthrough, but making it reproducible.

For Anscare, the development of the biofilm detection kit marked its first venture into the field of in vitro diagnostics (IVD). From material selection and quality management to regulatory validation, entirely new standards had to be established throughout the

development process. The surfactants and dyes used within the detection kit must react rapidly with EPS while maintaining stability under different environmental and storage conditions. If the reaction is too strong, diagnostic accuracy may be compromised. If it is too weak, the biofilm may not be visualized effectively.

After extensive rounds of testing and validation, the materials team identified a formulation that consistently delivered optimal binding performance with EPS. Based on the characteristics of the dye system, they also developed light-protective packaging and comprehensive quality-control procedures to ensure consistent performance across every production batch.

The journey from academic research to a clinically deployable medical product took more than eighteen months. What it represents is more than a technology transfer. It is the process of transforming laboratory discoveries into practical tools that healthcare professionals can rely on in everyday clinical practice. For medical products, success is not measured by whether something can be achieved once; it is measured by whether the same result can be delivered consistently, every single time.

When Treatment Can Go Home with the Patient

Identifying the problem is only the first step. The next challenge is treatment itself.

Negative Pressure Wound Therapy (NPWT) has long been regarded as an important treatment modality for complex wounds. By maintaining a controlled negative-pressure environment, it helps remove exudate, reduce the risk of infection, and create a moist environment conducive to tissue repair. Traditional NPWT systems, however, are often bulky and require a constant power supply. As a result, patients frequently face limitations in mobility, making it difficult to balance treatment with everyday life.

The SIMO NPWT System was designed to change that.

Through a precisely engineered spring-and-chamber mechanism, SIMO is able to maintain a consistent negative pressure of 125 mmHg without requiring electricity. Combined with a multilayer dressing structure and medical-grade silicone materials, the system delivers fluid management, leakage prevention, and secure fixation in a single solution, while allowing patients to continue their daily activities without compromising treatment effectiveness. Even showering becomes simpler. Patients only need to temporarily clamp the tubing rather than remove the entire system.

A moisture-indicating layer within the dressing provides a visual cue for dressing replacement, while an audible alert notifies users if the negative pressure falls outside the intended range, helping patients and caregivers identify potential issues early.

In clinical practice, physicians often cite not only improved treatment outcomes but also meaningful improvements in patients' quality of life. Patients who once depended on stationary medical equipment for extended periods can now maintain greater mobility and independence while continuing treatment. For many people, wound care is not simply a period of waiting for a wound to heal; it is the beginning of a gradual return to everyday life.

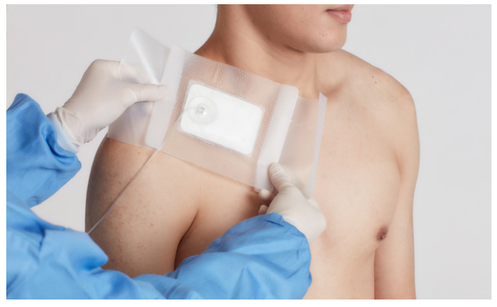
Materials Change More Than Products

From rapid biofilm detection to portable negative pressure wound therapy, Anscare's vision is to create a comprehensive wound management pathway that spans problem identification, diagnosis, and ongoing treatment.

Supporting this pathway is a broad portfolio of material technologies, including hydrocolloids, hydrogels, and medical-grade silicone, combined with a continuous commitment to understanding and addressing clinical needs.

When materials science enters the clinical setting, the impact extends far beyond the functionality of a dressing or the design of a device—it transforms the efficiency and quality of the entire care process. Diagnosis becomes more timely. Treatment becomes more continuous. Care becomes better integrated into daily life. Most importantly, patients are given greater opportunities to return to the routines and lifestyles that matter to them.

For BenQ Materials, success has never been defined by creating a single product. It is defined by using materials innovation to help move every clinical decision and every stage of care one step forward.



Acne Deserves to Be Taken Seriously

Treating Acne Like a Wound: The Product Evolution Journey Driven by Real User Needs

Anyone who has struggled with acne knows that the real frustration often extends beyond the blemish itself. Redness, swelling, recurring inflammation, and lingering post-acne marks can persist long after a breakout appears. DermaAngel was born from these seemingly small yet deeply relatable challenges.

For most people, acne is viewed as a skincare concern. For the DermaAngel team, however, it is also a form of skin injury that deserves proper care. When the R&D team began looking at acne through the lens of wound care, it opened a development path fundamentally different from that of conventional beauty products. From material selection to product design, every improvement has been guided by the same question: What do users truly need?

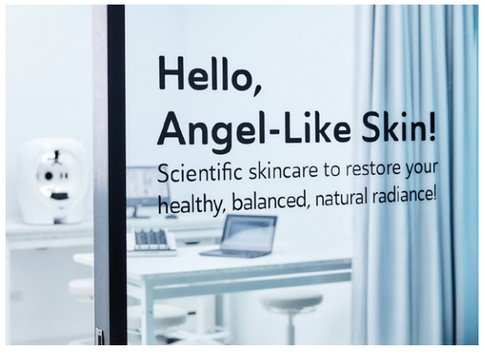
A Moment of Inspiration That Changed How Acne Was Viewed

The story of DermaAngel began with a simple yet pivotal question.

At the time, BenQ Materials had already accumulated extensive expertise in hydrocolloid technology. Widely used in medical wound dressings, hydrocolloids are known for their ability to absorb exudate, maintain a moist healing environment, and protect damaged skin. During a product discussion, an engineer who had long struggled with acne posed an intriguing idea: if hydrocolloids could help care for wounds, could they also be used to care for acne?

That question became the starting point of DermaAngel. From a skin repair perspective, acne is fundamentally a localized process involving inflammation and tissue damage.

Today, DermaAngel has expanded beyond Taiwan into markets across Southeast Asia, Australia, New Zealand,



the United Kingdom, Europe, the United States, and the Middle East, becoming a familiar acne patch brand for consumers around the world.

Yet, what continues to drive the brand's evolution is not the material itself; it is the needs, feedback, and expectations of the people who use it.

A Key Decision: Creating More Targeted Solutions for Every Stage of Acne

In the past, consumers typically used acne patches in a straightforward way: when a breakout appeared, they applied a patch and continued using the same product throughout the entire process.

However, the DermaAngel team observed that this behavior did not necessarily mean that one product was suitable for every situation. Rather, it reflected the lack of more nuanced product offerings available in the market.

In reality, acne progresses through distinct stages. From clogged pores and inflamed redness to the development of a mature whitehead, followed by skin recovery and the appearance of post-acne marks, each stage presents different challenges and care needs. This insight led the team to an important decision: rethink acne care from the perspective of the acne lifecycle and create finely segmented regimens to address the specific needs of each stage.

As a result, the Acne Patch Plus (Intensive Green) was developed for early-stage inflammation and emerging whiteheads. The Acne Patch (Invisible Yellow) was designed for mature whiteheads, while the Spot Lightening Patch (Brightening Pink) was created to help

care for the skin after breakouts have subsided and post-acne marks begin to appear.

The same philosophy also extends to different usage scenarios. For hard-to-fit areas such as the chin and hairline, the team developed Flex-fit acne patch with crescent-shaped that better conform to facial contours. Larger-format patches were also introduced to address acne-prone areas on the chest and back.

Behind every product refinement lies the same guiding question: What do users truly need?

What Matters Most to Users Is Often Hidden in the Details

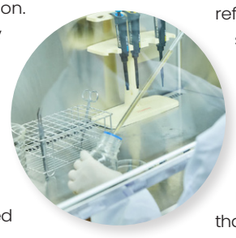
When it comes to acne patches, absorption performance is one of the factors consumers care about most. Through extensive testing and repeated formulation refinements, DermaAngel successfully developed an optimized hydrocolloid formulation with significantly enhanced fluid absorption capacity. According to DermaAngel, the brand applies the same rigorous standards across from R&D to manufacturing, using scientific proven and product quality to address real consumer care needs.

Because acne often affects personal appearance and self-confidence, consumers also place a high value on how discreet an acne patch appears on the skin. In addressing this need, the DermaAngel R&D team discovered that the key to invisibility is not simply thickness, but the way light interacts with the patch.

DermaAngel's functional patches feature a thicker center and ultra-thin edges. The edge thickness measures only about 0.1 mm, while a specially engineered contour helps minimize the transition between the patch and the skin, reducing visible light contrast along the edges.

Structural design is only part of the equation. The choice of backing film material is equally important. Even the thinnest patch can be easily noticed if its surface creates visible reflections.

To address this challenge, the team conducted multiple rounds of material testing to explore how light could be diffused rather than directly reflected. Each iteration was aimed at achieving a more natural and discreet appearance without compromising performance.



When Consumer Needs Are Recognized, Materials Gain a Direction for Innovation

All DermaAngel products are manufactured at BenQ Materials' Yunlin facility, where the entire process, from material formulation to final packaging, is managed in-house. For the R&D team, material design is not solely about product performance. It must also deliver a comfortable and intuitive user experience.

Adhesion, for example, represents one of the most important design challenges. If the adhesive is too weak, the patch may detach during sleep or physical activity. If it is too strong, removal may cause discomfort.

Finding the right balance between secure adhesion and easy removal is a challenge that every product generation must repeatedly test and refine.

Hydrocolloid materials must also withstand high-temperature processing during manufacturing while retaining the softness and flexibility needed to conform comfortably to the skin after cooling. Achieving this balance requires considerable formulation expertise.

In addition, all materials intended for prolonged skin contact must undergo irritation and sensitivity assessments to ensure user safety. To further strengthen product validation before launch, the brand established the Angelab – BSL-2 (P2) Research Laboratory, equipped with skin analysis instruments, a cell laboratory, and a microbiology laboratory. Through these capabilities, the team continuously evaluates product safety, preservative efficacy, and formulation stability, ensuring that every innovation is supported by scientific evidence.

The Real Force Behind Product Progress Has Always Been the User

Over the past decade, DermaAngel has grown from a single acne patch into a comprehensive portfolio spanning hydration and skin-balancing care, products for oily and acne-prone skin, and solutions targeting dark spots and skin radiance. Along the way, the brand has gradually established a distinct positioning centered on salicylic acid-based skincare.

Looking back, however, some of the brand's most valuable sources of innovation have come not only from the laboratory but also from user feedback. Concerns about redness, patch detachment, visibility, surface reflection, and post-acne marks have all helped shape the direction of product development.

For DermaAngel, material science may have been the starting point, but the true driver of innovation has always been the people who use its products. It is this ongoing dialogue with consumers that has enabled a technology rooted in wound care to evolve into solutions that better address the needs of everyday life.

At Least Seven Validation Gates Before a Single Wound Dressing Reaches the Market

From Cleanroom to Bedside: How a Medical Device Earns Trust

It takes only seconds for a nurse to open a package, but before that wound dressing ever reaches a patient, it has often undergone years of development and hundreds of tests. From biocompatibility and sterility validation to the precise alignment of multilayer structures, every step is designed to reduce the possibility of medical risk. At Anscare, manufacturing is guided by a single principle: every result must be as reliable as the first.

Stepping inside an Anscare manufacturing facility, the first impression is not speed, but a rhythm defined by precision and control.

Roll stock advances steadily along the production line as multiple material layers are synchronized and laminated through Roll-to-Roll manufacturing systems. Nearby, Automated Optical Inspection (AOI) systems continuously scan every surface, monitoring dimensions, edge integrity, and coating quality in real time. Even the slightest deviation is immediately detected and intercepted before it can proceed to the next stage of production.

The manufacturing philosophy behind medical materials differs fundamentally from that of consumer products. The objective is never simply to produce faster, but to achieve the same result every time. Because in healthcare, what matters most is not a single successful outcome, but consistent performance that can be verified repeatedly over time.

The Same Material, the Same Quality—Consistent Quality at Every Stage of Production

The most fundamental difference between medical materials and ordinary products lies in the near absence of room for error. If an electronic device malfunctions, a simple restart may solve the problem. But if a medical dressing is inadequately sterilized or a material exhibits toxicity, patient safety may be directly compromised. In medical manufacturing, the acceptable margin for error must approach zero. This principle serves as the baseline that every process at Anscare is designed to uphold.

Take the dressings used with the SIMO Negative Pressure Wound Therapy System (SIMO NPWT) as an example. Each dressing incorporates multiple functional layers, working together to manage exudate, maintain breathability, prevent leakage, and ensure secure fixation. Once laminated together, the alignment accuracy between layers directly affects the dressing's ability to conform to the wound and maintain an effective negative-pressure seal.

"Even a slight misalignment in one layer can lead to progressively greater deviations downstream." It is a challenge the manufacturing team confronts every day.

To ensure precise alignment in every dressing produced, the production line incorporates specially designed positioning fixtures that guide each material layer into its exact location. After all, quality issues should be identified on the production floor—not in the hospital ward.

Even a Single Dressing Travels a Longer Journey Than You Might Expect

Yet manufacturing is often not the most time-consuming aspect of developing a medical device. Validation is.

From the moment a concept takes shape, a product must be supported by a comprehensive testing and validation framework, and no stage can be omitted.

The process begins with biocompatibility testing in accordance with ISO 10993 standards. Material extracts are brought into contact with cells to verify that they are non-cytotoxic, non-sensitizing, and non-irritating to the skin. In total, the evaluation encompasses more than seven assessment criteria. Next comes sterilization validation. Whether using gamma irradiation or ethylene oxide (EO) sterilization, every device must be verified to maintain complete sterility upon release.

Performance stability testing follows, simulating changes in product performance after three to five years of storage to confirm that material properties remain stable throughout the designated shelf life. For the SIMO system, an additional pressure retention test is required. Each device must demonstrate its ability to consistently deliver a negative pressure of 125 mmHg throughout use. This value is also widely recognized in clinical literature as the standard reference pressure for negative pressure wound therapy.

The manufacturing environment itself is also part of the validation process.

Anscare's facilities maintain medical-grade cleanroom conditions of Class 100,000 or better. In addition to controlling temperature and humidity, the facilities undergo routine monitoring of airborne particulates and viable microbial counts. Every incoming batch of raw materials must be accompanied by a supplier-issued Certificate of Analysis. Upon receipt, the materials undergo additional internal quality inspections to verify the absence of heavy metals, plasticizers, and other unwanted contaminants. All production records are retained for a minimum of ten years.

From raw materials to final release, every stage of the process must be fully documented because traceability itself is an integral part of medical quality.

For SIMO, the journey from initial development to regulatory approval took more than four to five years. Yet the greatest challenge has never been technological innovation alone. The real challenge is ensuring that the product delivers consistent performance across different temperatures, humidity levels, and real-world clinical conditions.

True Trust Is Built on Consistency

Today, Anscare's SIMO system has been adopted by many of Taiwan's leading medical centers. In 2024, the technology received Taiwan's National Innovation Award through a collaboration with the Division of Plastic Surgery at National Taiwan University Hospital. Earlier, in 2017, it was also recognized with the prestigious Red Dot Design Award in Germany.

For medical products, however, trust is never built on a single award or a single success. Rather, it is earned through consistent reliability. Every product leaving the factory must perform to the same standard as the one before it, and every production record retained for ten years must provide clear traceability whenever verification is required.

At Anscare, manufacturing has never been simply about producing medical materials. It is about ensuring that every product entering a clinical setting is worthy of the trust placed in it.

Seeing Beyond the Surface

How a Breakthrough in Biofilm Research May Transform the Diagnosis and Treatment of Chronic Wounds

Wound healing is often taken for granted. Yet for many patients living with chronic wounds, it can become a prolonged and frustrating journey. Recent medical research suggests that bacterial biofilms may be an important factor contributing to delayed healing, even when standard wound care has already been provided.

For years, clinicians caring for chronic wounds that failed to heal often had to rely largely on clinical experience to determine the underlying cause. Even when physicians recognized that a wound was not progressing as expected, determining whether the delay was related to circulation, pressure, diabetes, infection, biofilm, or other local and systemic factors was not always straightforward.

Professor Nai-Chen Cheng, Chief of the Division of Plastic Surgery, Department of Surgery, National Taiwan University Hospital, and Associate Dean of the National Taiwan University College of Medicine, has devoted years to studying chronic wounds and tissue regeneration. In recent years, his research has focused on the role of biofilms in wound healing. The Wound Biofilm Detection Kit developed by his team was recognized with the National Innovation Award for Clinical Innovation for helping clinicians identify possible biofilm-related complications in chronic wounds more rapidly and objectively. For Professor Cheng, however, the award is not the ultimate goal. What matters most is translating scientific discovery into clinical practice—helping healthcare professionals uncover what was previously hidden and make more informed treatment decisions.

An Invisible Adversary Within the Wound

Most people associate wound infection with classic signs such as redness, swelling, warmth, and pain. They also understand that symptoms such as expanding redness, increasing pain, pus, foul odor, or fever warrant prompt medical attention. In clinical practice, however, many chronic wounds that fail to heal present quite differently.

Professor Cheng observed that even after blood glucose levels are well controlled and circulatory issues have been addressed, some wounds continue to show little or no progress toward healing. Although these wounds may appear relatively stable on the surface, they often remain trapped in a state of persistent low-grade inflammation. In many cases, biofilms may be an important underlying contributor, often acting together with local and systemic factors such as pressure, edema, impaired circulation, diabetes, repeated trauma, and reduced host immunity.

A biofilm can be thought of as a protective, sticky matrix formed when bacteria gather together and establish a highly organized community. Sheltered within this structure, bacteria become significantly more resistant to immune defenses and antimicrobial therapies. As a result, they can survive treatment, persist within the wound, and repeatedly recolonize the affected tissue. What makes biofilms particularly challenging is that they do not always produce the hallmark signs of infection, allowing them to remain undetected and untreated for extended periods.

Professor Cheng also mentions that biofilms are not always confined to the wound surface. They may extend into deeper tissues, making them difficult to eliminate through topical treatments alone. This is one of the reasons why chronic wound management is often far more complex than it initially appears.

A New Direction in Wound Care: From Infection-Focused to Biofilm-Based Treatment

Historically, wound management has centered on controlling infection and promoting healing. However, as scientific evidence continues to accumulate, the international wound care community has increasingly recognized that, in many hard-to-heal wounds, the problem is not infection alone—it is biofilm.

In recent years, the concept of biofilm-based wound care (BBWC) has emerged as an important clinical approach.

At the heart of this approach is repeated wound bed preparation: cleansing, debridement, disruption of the biofilm structure, and the use of dressings or therapeutic agents designed to prevent biofilm reformation and inhibit bacterial recolonization. Ongoing monitoring and evaluation are then used to assess wound progress over time. Because biofilm can reform rapidly, repeated debridement, dressing adjustments, or changes in treatment strategy may be required before the wound can return to a normal healing trajectory.

Identifying the Problem Remains a Major Challenge

Although the clinical significance of biofilms is now widely recognized, one persistent challenge remains: how can clinicians determine whether a wound actually contains biofilm?

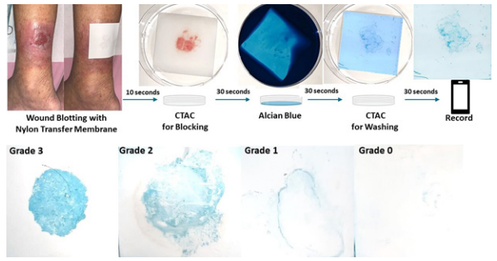
For many years, physicians have had to rely largely on clinical experience. A wound that fails to heal or repeatedly exhibits signs of inflammation may raise suspicion of biofilm involvement. Confirming its presence, however, has traditionally required advanced tools such as electron microscopy or specialized staining techniques—methods that are costly, time-consuming, and impractical for routine outpatient care.

"In many cases, it is only after treatment fails that we begin to suspect biofilm may be the underlying cause," says Professor Cheng.

This uncertainty not only complicates clinical decision-making but may also delay timely intervention for patients.

From the Laboratory to the Clinic: Enabling Rapid Biofilm Identification

Recognizing this unmet clinical need, Professor Cheng's team brought together the expertise of the Division of Plastic Surgery, Department of Surgery, National Taiwan University Hospital, and the Institute of Biomedical Engineering at National Tsing Hua University to develop a practical biofilm detection technology for wound care. Yet translating a research concept into a clinically usable tool required overcoming a significant gap between laboratory development and real-world practice. To bring the technology into clinical application, the team partnered with BenQ Materials to advance technology transfer and commercialization. Leveraging the company's expertise in medical materials, manufacturing, and regulatory validation, the technology was successfully transferred in 2023, paving the way for its integration into clinical wound care practice.



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The technology's key innovation lies in its ability to transform a laboratory-based detection concept into a rapid, point-of-care clinical assessment tool.

Using a specially designed sampling substrate that comes into contact with the wound surface, followed by a staining and analytical process, clinicians can obtain results within minutes. The test is designed to help identify the presence of biofilm and may further provide insight into its distribution and relative severity. The results should be interpreted as an adjunct to the clinician's assessment of wound appearance, medical history, vascular status, infection signs, and overall patient condition.

For healthcare professionals, this represents more than simply another diagnostic test. It provides additional objective information for treatment planning. For example, clinicians may be able to make earlier and more informed decisions regarding debridement or the use of anti-biofilm dressings. Following treatment, repeat testing may also help assess treatment effectiveness, reducing reliance on visual inspection and clinical judgment alone. As with any diagnostic aid, continued clinical validation and correlation with patient outcomes will be important for defining its role in routine wound care.

The Next Frontier in Wound Care: Advancing Toward Precision Care

As both a plastic surgeon and medical researcher, Professor Cheng's long-standing focus has never been on a single product, but rather on how to make wound care more precise and effective.

In his view, the future of wound medicine will depend not only on how a wound looks, but also on what is happening biologically within it. Emerging innovations—including smart dressings, real-time sensing technologies, biosignal monitoring, and novel therapeutic approaches such as cell therapy and exosome-based treatments—have the potential to reshape the future of wound management.

Before advanced wound technologies can reach their full potential, clinicians must first identify the biological barriers that prevent healing. Biofilm detection offers one important step in that direction. By making an invisible problem more visible, it may help wound care move from experience-based judgment toward more precise, individualized treatment.

從材料科學到健康照護 Touching Every Moment 的起點

從材料研發到健康照護，明基材料走過二十多年的技術演進之路。當材料科學開始回應醫療需求，每一次創新，都不只是技術突破，更是對生命與健康的長期承諾。

陳建志
董事長兼執行長

一家材料公司，為什麼會走進醫療？這個問題，幾乎伴隨著明基材料每一次跨入新領域時被提出。

從光碟片、偏光片、光學薄膜，到電池隔離膜、防水透氣機能膜，再到今天橫跨專業醫療、視力照護、肌膚健康與滅菌防護等多元健康應用，表面上看來，這是一條不斷跨界的發展路徑；但如果回到企業創立的初心來看，明基材料其實始終走在同一條道路上。

創新的起點，是解決問題

明基材料的前身達信科技成立於 1998 年。當時的第一個產品是光碟片，但公司的定位從來不只是光碟製造商，而是一家以材料化學為基礎的科技公司。多年來，明基材料持續深耕高分子材料、成膜、拉伸、塗佈、貼合與精密製程能力，並透過不同技術平台的組合與延伸，逐步建立起跨產業的材料應用能力。

從光碟片到偏光片，是一次重要的轉型；從顯示材料走向能源材料與醫療應用，則是另一段新的旅程。然而在每一次轉型背後，真正沒有改變的，其實是對材料科學的持續探索。

我們相信，一項核心技術的價值，不在於它被應用在哪一個產業，而在於它能否持續創造新的可能。

同樣一項成膜與拉伸技術，可以成為顯示器中的偏光片，也可以成為鋰電池中的隔離膜；可以形成防水透氣的機能織物，也能轉化為醫療產品中關鍵的保護材料。材料的世界看似微小，卻能決定產品的性能、品質與使用體驗，甚至影響一個人的健康與生活。

從產業應用到健康價值

當材料技術的能力持續累積，醫療自然成為明基材料思考下一步發展的重要方向。事實上，醫療並非一次突然的跨界，而是企業能力長期演化後的必然延伸。

從集團層面來看，早在二十多年前，明基佳世達集團便開始布局醫療事業，從醫療服務、設備、耗材到健康通路，逐步建構完整的健康照護版圖。而對明基材料而言，則選擇以自身最擅長的材料科學為起點，走出不同於多數電子產業投入醫療設備的發展路徑。

今天，明基材料已建立涵蓋臨床醫療解決方案（Clinical Solutions）、滅菌屏障系統（Sterilization Barrier Solutions s）、衛生照護解決方案（Hygiene Solutions）、視力照護（Vision Care）以及肌膚健康（Skin Wellness）五大醫療科技應用領域。

看似不同的產品與市場，背後其實共享同一套核心能力。

從高分子材料設計、精密塗佈、薄膜成形，到貼合與驗證技術，這些能力在不同產業之間持續交互運用，也讓明基材料能夠從材料供應商，逐步發展成為醫療科技平台。

因為我們始終相信，材料的價值不在材料本身，而在於它最終能為人帶來什麼改變。

用時間建立信任

如果說電子產業追求的是創新，那麼醫療產業追求的則是信任。這是明基材料投入醫療後最深刻的體會。

創新可以在短時間內完成，但信任往往需要數年、甚至數十年的累積。一項產品從研發到真正進入醫療現場，不只需要技術突破，更必須經過法規認證、品質驗證、臨床應用與市場考驗。

多年來，明基材料持續建立從材料研發、產品設計、精準製造到品質驗證的完整能力，希望讓每一項創新都能被市場信任、被醫療體系接受。

在我們看來，品質不只是製造流程中的一個環節，而是品牌存在的基礎。

因為任何一個細節的疏忽，都可能影響醫療結果；而每一次穩定且一致的表現，都是信任累積的一部分。

從產品進入工廠的那一刻開始，到最終被使用者拿在手上，每一道製程、每一次檢驗、每一項驗證，都是為了確保產品在最關鍵的時刻，能夠如預期般發揮作用。

每一個醫療瞬間，都是明基材料存在的理由

「Touching Every Moment」所代表的意義，在於每一個重要時刻，都值得被更好的材料支持。它不只是品牌的一句口號，更是明基材料對醫療科技的理解。

無論是從病患面對疼痛與不安，到醫護人員做出關鍵判斷的時刻；或是從傷口開始癒合，到人們重新回到正常生活的時刻，材料科技都應該在背後默默發揮作用。

未來，明基材料將持續以材料科學為根基，結合精準製造、品質驗證與全球布局能力，打造更完整的健康科技平台。我們不為技術而創新，而是希望讓創新真正走進醫療現場、融入日常生活，並在每一個需要被照護的時刻發揮價值。

因為我們相信，科技最終的目的，不只是創造產品，而是改善人們的生活；而每一個被妥善照護的瞬間，都值得被更好的材料支持。

「Touching Every Moment, powered by Materials Science」這不只是明基材料的醫療願景，也是我們持續前進的方向。

從發現問題到解決問題

一場從診斷到照護的材料革命，正在改變傷口管理方式

傷口照護看似只是換藥與包紮，但真正影響癒合的關鍵，往往藏在肉眼看不見的地方。從生物膜感染判讀到居家負壓治療，材料科技正逐步改變傷口照護的方式，也讓治療能更早介入、更不影響日常生活。

近年來，傷口照護的發展逐漸從「選擇更好的敷料」，走向「建立更完整的照護流程」。明基材料旗下安適康（Anscare）所投入的生物膜感染檢測套組與 SIMO 負壓治療系統，正是從臨床需求出發，分別回應傷口照護中兩個最重要的問題：如何更快找到問題，以及如何讓治療持續發生。

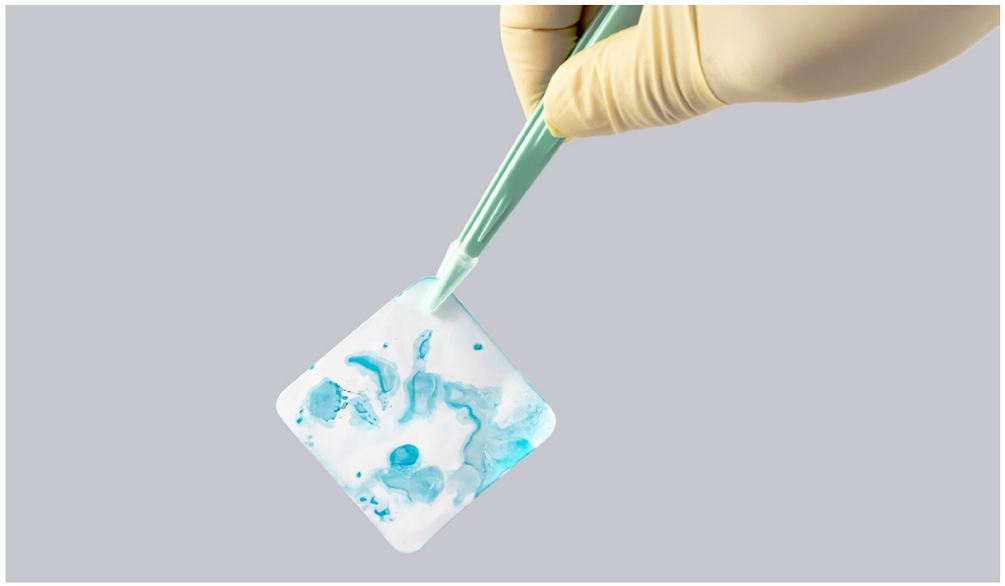
看見問題，才能真正開始治療

慢性傷口的難題，從來不只是表面難以癒合。對許多患者而言，真正棘手的是傷口長時間停留在發炎狀態，反覆感染、滲液增加，組織始終無法順利修復。這不僅影響生活品質，也持續消耗醫療與照護資源。

近年研究顯示，約八成慢性傷口伴隨生物膜生成。當細菌附著於傷口表面後，會持續分泌細胞外聚合物（EPS），逐漸形成具有保護作用的膜狀結構。這層生物膜不但會阻礙抗生素滲透，也會降低外用藥物與敷料的效果，使傷口長期停留在慢性發炎期，成為許多難癒合傷口背後的隱形原因。

然而，生物膜最大的挑戰在於「看不見」。過去臨床上若要確認生物膜是否存在，必須採集檢體送往實驗室培養，往往需要兩到三天才能取得結果。在等待期間，醫護人員多半只能依據經驗判斷是否需要進一步清創或加強抗菌處置，容易錯失最佳介入時機。

為了解決這項臨床缺口，安適康與台大醫院整形



外科及清華大學合作開發「Anscare 傷口生物膜感染檢測套組」，將原本需要數天才能完成的檢測流程，縮短至 5 至 10 分鐘即可於床邊完成判讀。對醫療現場而言，最大的改變不只是速度，而是讓診斷能夠更早介入，協助醫師在第一時間做出更精準的治療決策。

從研究成果到臨床工具，挑戰才正要開始

一項創新技術真正困難的地方，往往不是研發成功，而是如何穩定地被複製。

對安適康而言，這是首次跨入體外診斷試劑（IVD）領域。從材料選型、品質管理到法規驗證，每一個環節都必須重新建立標準。檢測套組中的介面活性劑與染劑，不僅要能快速與生物膜中的 EPS 產生反應，還必須在不同環境與保存條件下維持穩定性。反應太強可能影響判讀準確度，反應太弱又無法有效顯色。

材料團隊歷經反覆測試與驗證，最終找到與 EPS 結合效果最穩定的配方，並因應染劑特性設計避光包裝與品質控管流程，確保每一批產品都能維持一致的檢測結果。

從學術研究到醫療產品，這段歷程歷時超過一年半。背後反映的不只是技術轉移，更是將實驗室成果轉化為臨床可用工具的過程。因為對醫療產品而言，真正重要的不只是能不能做到，而是每一次都能做到一樣好。

當治療可以跟著病人一起回家

找到問題之後，接下來的挑戰才是真正的治療。

負壓傷口治療（NPWT）長期被視為複雜傷口的重要治療方式，透過持續負壓環境協助移除滲液、降低感染風險，並建立有利於組織修復的濕潤環境。然而，傳統設備體積龐大且需要插電，患者在治療期間往往受到活動限制，治療與生活難以同時兼顧。

SIMO 負壓治療系統則試圖改變這件事。

透過精密彈簧與腔體結構設計，SIMO 無須用電即可穩定維持 125mmHg 負壓值。搭配多層結構敷料與醫療級矽膠材料，不僅兼具吸收、防滲與固定功能，也讓患者在日常活動中維持穩定治療效果。即使洗澡，也只需簡單夾閉管路，無須拆除整套系統。

敷料中的顯濕圖層能提醒更換時機，負壓異常時則會發出警示聲響，協助患者與照護者及早察覺問題。

臨床上，醫師最常提到的改變，不只是治療效果，而是患者生活方式的改變。過去需要長時間依賴醫療設備的患者，如今能夠在接受治療的同時維持日常活動。對許多人而言，傷口照護並非等待癒合的過程，是期待逐漸回到正常生活的開始。

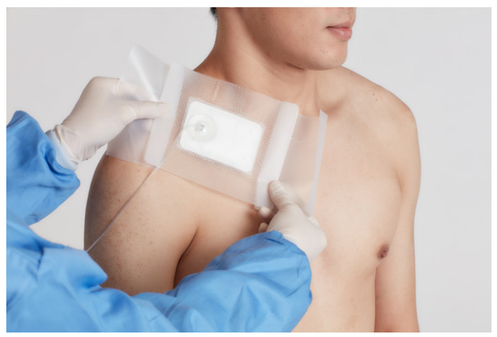
材料改變的，從來不只是產品

從生物膜快篩到可攜式負壓治療，安適康希望建立的，是一條從發現問題、確認原因到持續治療的完整傷口管理路徑。

背後支撐這條路徑的，是水膠體、水凝膠與醫療級矽膠等多項材料平台能力，以及對臨床需求的持續理解與回應。

當材料科技走進醫療現場，改變的不只是敷料的功能或設備的外型，而是整個照護流程的效率與品質。診斷更即時、治療更連續、照護更貼近日常生活，也讓患者有更多機會回到原本的生活節奏。

對明基材料而言，真正重要的從來不是做出一項產品，而是透過材料創新，讓每一次醫療決策、每一段照護歷程，都能往前推進一步。



長痘痘這件事，值得被好好對待

把痘痘當成傷口認真處理，從使用者需求出發的產品進化之路

每個長過痘痘的人都知道，真正困擾人的往往不只是痘痘本身，而是紅腫、反覆發炎、留下痘印，而痘痘貼也是在長痘過程中。護妍天使（DermaAngel）的誕生，正是從這些看似微小卻真實存在的困擾出發。

在多數人的認知裡，痘痘是肌膚保養問題；但在護妍天使團隊眼中，它其實也是一種需要被妥善照顧的肌膚傷口。當研發人員開始用傷口照護的角度重新看待痘痘，也開啟了一條不同於傳統美妝產品的發展路徑。從材料選擇到產品設計，每次改良的背後，起源於同一個問題：使用者真正需要的是什麼？

一個靈光一閃，重新看見痘痘的本質

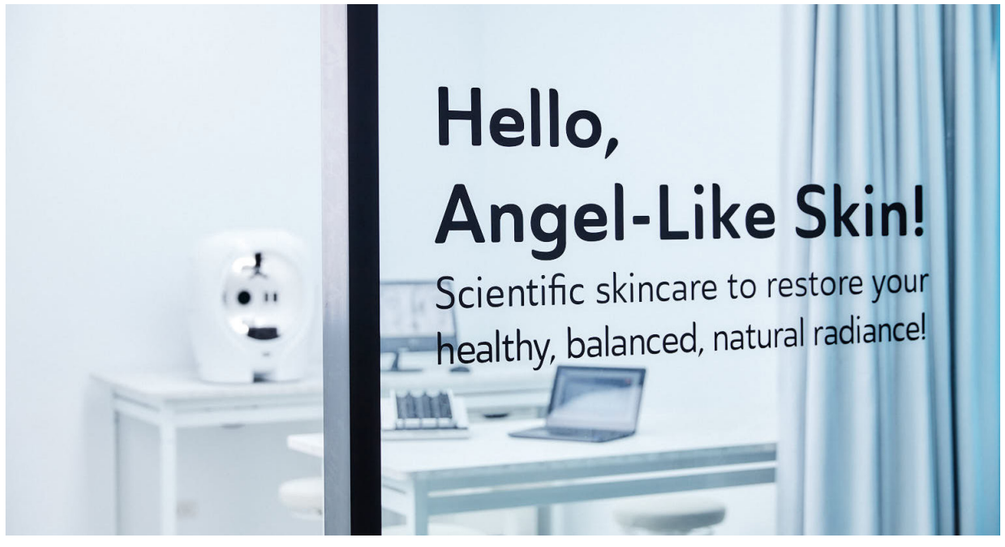
護妍天使的起點，來自一個簡單卻關鍵的提問。

當時，明基材料已長期投入水膠體材料技術研發，這項材料廣泛應用於醫療傷口敷料，具備吸收組織液、維持濕潤環境與保護傷口等特性。某次討論中，飽受長痘困擾的工程師提出一個想法：如果水膠體能照顧傷口，是不是也能運用在痘痘照護上？

這個問題成為護妍天使的起點。從皮膚修復的角度來看，痘痘即是一種局部發炎與組織受損的過程。

如今，護妍天使已從台灣出發，進入東南亞、澳紐、英國、歐洲、美國與中東市場，成為許多消費者熟悉的痘痘貼品牌。

然而，真正推動產品持續進化的，並不只是材料本身，而是每位使用者提出的需求與期待。



關鍵決策：產品細緻化發展，解決不同階段的問題

過去，消費者使用痘痘貼的方式往往很直接：長了痘痘就貼，同一款用到底。

但護妍天使團隊在觀察使用習慣後發現，這樣的現象未必代表一款產品真的適用所有狀況，而是市場過去很少提供更細緻的選擇。

事實上，痘痘從形成到消退，歷經不同階段。從毛孔阻塞、發炎紅腫，到白頭成熟，再到後續修復與痘印形成，每個階段面對的問題其實都不同。因此，團隊做出了一個重要決策：從痘痘形成的過程中，重新思考不同階段真正需要的照護，細緻化產品線發展。

於是，針對初期紅腫與白頭階段推出高效綠款；針對白頭成熟期設計金隱形款；而在痘痘消退後，則發展出聚焦痘印護理的粉修護款產品。

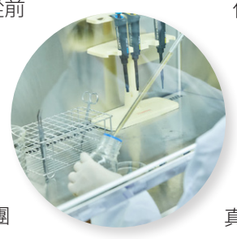
同樣的思維也延伸到使用情境。針對下巴、髮際線等部位，團隊開發月牙型痘貼以符合輪廓貼合使用；也推出大面積覆蓋款式，滿足胸背部肌膚需求。

每次產品設計的調整，背後的思考都來自於：使用者真正需要的是什麼？

使用者最在意的事，往往藏在細節裡

針對痘痘貼的使用，消費者最重視的是吸收力，護妍天使歷經反覆的測試，成功開發出能顯著提高吸液能力的最佳配方。護妍天使表示，品牌從前端研發到生產製造皆秉持嚴謹態度，旨在以實證數據與高品質，切實回應使用者的護理需求。

由於青春痘常對個人外貌造成困擾，消費者在尋求遮瑕與修飾時，對痘痘貼的「隱形度」亦有極高要求。護妍天使研發團隊針對此項外觀需求發現，影響視覺感受的關鍵不只是厚度，而是光線。



護妍天使功能款採用「內厚外薄」結構設計，邊緣厚度僅約 0.1 毫米，並透過特殊曲線設計降低貼片與肌膚之間的斷差感，讓光線不易在邊緣形成明顯落差。

除了結構設計，背膜材質的選擇同樣重要。只要表面產生反光，即使貼片再薄，也容易被察覺。

為了解決這個問題，團隊歷經多輪材料測試，研究如何讓光線產生散射而非集中反射，每次的嘗試皆是為了產品效果能有更理想的呈現。

當需求被看見，材料就有了進化方向

護妍天使所有產品皆在明基材料雲科廠完成生產，從原料配方到最終包裝，全程自主掌握。對研發團隊而言，材料設計不只是追求效果，更要兼顧消費者使用感受。

例如黏性的拿捏，也是重要挑戰之一。黏性不足，睡覺翻身或流汗時容易脫落；黏性過強，又可能在撕除時造成不適。

如何在「貼合佳」與「好撕除」之間找到平衡，是每一代產品都必須反覆驗證的課題。

水膠體材料在製程中需要經過高溫壓製，冷卻後又必須恢復柔軟與彈性，才能穩定服貼於肌膚，考驗配方設計能力。

此外，所有與肌膚長時間接觸的材料，也都必須通過刺激性與敏感性評估。為了讓產品上市前完成更完整的功效驗證，品牌進一步建置「天使肌科研所」，透過肌膚檢測儀器、細胞實驗室與微生物實驗室，持續驗證產品的安全性、防腐效能與配方穩定性。

真正推動產品進步的人，始終是使用者

走過十多年，護妍天使從一張小小的痘痘貼延伸至保濕調理、油痘肌保養、淡斑透亮等系列產品，並逐步建立以水楊酸護理為核心的品牌定位。

但回頭看，品牌最重要的研發資料，除了實驗室外，還有那些關於紅腫、脫落、反光、留痕的回饋，都是產品持續進化的方向。

對護妍天使而言，材料科技是起點，真正推動創新的始終是每位使用者。也讓這項源自傷口照護的材料，更貼近人們真實的生活。

一片醫療敷料上市前，要通過至少七道驗證關卡

從無塵室到病房，一件醫療器材怎麼證明自己值得信任

護理師拆開包裝只需要幾秒鐘，但這片敷料進入病房之前，往往已歷經數年開發與上百次測試。從生物相容性、無菌驗證到多層結構的精密對位，每一道工序都在降低醫療風險發生的可能。在安適康（Anscare）的工廠裡，製造只有一個原則：每一次結果，都必須跟第一次一樣穩定。

走進 Anscare 工廠，最先感受到的不是速度，而是一種近乎精準控制的節奏。

捲料沿著產線緩慢前進，多層材料在 Roll-to-Roll 設備中同步貼合；另一側，自動光學檢測系統（AOI）持續掃描每一片材料表面，即時監測尺寸、邊緣與塗布狀態。只要出現極細微的偏差，系統便會立即攔截，不再進入下一道工序。

醫療材料的製造邏輯，從一開始就與消費性產品不同。這裡追求的從來不是「做得快」，而是每一次都必須維持一致結果；因為對醫療產品而言，真正重要的從來不是單次成功，而是長時間、可被重複驗證的穩定性。

同一批材料，必須確保每道工序都維持相同品質

醫療材料與一般產品最根本的差距，在於容錯空間極低。電子產品出了問題，多半重新啟動即可；但醫療敷料若滅菌不全，或材料產生毒性，直接影響的可能就是病人安全。容錯率必須趨近於零，這是安適康製造現場每一道工序共同守住的底線。

以 SIMO 負壓治療系統配套的敷料為例，整體由多層材料構成，每一層分別負責吸收、透氣、防滲與固定。多層疊合後，層與層之間的對位精度，將直接影響敷料是否能完整貼附傷口、避免負壓洩漏。

「只要其中一層偏了，後面累積的誤差會越來越大。」這是製造端每天都在面對的挑戰。

為了確保每一片出廠的敷料都能精準對位，產線特別設計專屬定位輔具，引導各層材料落在正確位置。因為所有問題，都必須在生產線上被發現，而不是等產品進了醫院才被看見。

即使是一片敷料，上市前走過的路比想像中更長

然而，醫療材料真正耗時的，往往不是製造，而是驗證。

一件產品從概念成形開始，就必須同步建立完整測試流程，而且每一關都無法省略。

首先是生物相容性測試（依據 ISO 10993 標準）：材料萃取液須與細胞接觸，確認不具細胞毒性、不致敏、不刺激皮膚，整體涵蓋超過七項評估指標。接著是滅菌驗證，透過伽瑪射線或 EO 氣體滅菌，確保每件出廠器材都維持完全無菌狀態。

效能穩定性測試，則模擬產品存放三至五年後的性能變化，確認效期內材料特性仍能維持穩定。SIMO 裝置還需額外進行壓力維持測試，驗證每一顆裝置在使用期間，都能穩定輸出 125 毫米汞柱的負壓；這個數字，也是臨床文獻廣泛採用的標準負壓參考值。

而生產環境本身，同樣是驗證的一部分。

安適康工廠維持 Class 100,000 以上的醫療級無塵室標準，不僅控制溫濕度，也定期監測空氣中的微粒與浮游菌數量。每批進料皆須附有原廠分析證明書，入廠後還需再次進行內部品質管控，確認無重金屬或塑化劑殘留；所有生產紀錄則完整保留十年。

從原料到出廠，每一個環節都必須留下紀錄，因為可追溯性本身就是醫療品質的一部分。

以 SIMO 為例，從最初開發到正式取得認證，整體時程超過 4 到 5 年。然而，真正困難的從來不只是技術突破，而是如何讓產品在不同溫濕度、不同使用情境下，都維持相同結果。

真正的信任，來自每一次都一樣可靠

目前，安適康 SIMO 已導入台灣多數醫學中心，並於 2024 年與台大整形外科合作取得台灣國家新創獎，更早在 2017 年獲得德國紅點設計獎肯定。

但對醫療產品而言，真正建立信任的，從來不只是一次得獎或一次成功，而是每一片出廠的產品，都能和上一片一樣穩定可靠；每一份保留十年的生產紀錄，都能在需要追溯時清楚說明。

在安適康的工廠裡，製造的意義，從來不只是把材料做出來，而是讓每一個進入醫療現場的產品，都真正值得被信賴。

看見傷口裡的真相

一項生物膜研究，如何改變慢性傷口的治療與判斷

傷口癒合看似理所當然，對許多慢性傷口患者而言卻是一場漫長挑戰。近年醫學研究發現，細菌形成的「生物膜」可能是許多慢性傷口久治不癒的重要原因之一。

過去在傷口照護領域，醫師面對久治不癒的慢性傷口，往往只能根據臨床經驗判斷病因。即使醫師察覺某些傷口癒合狀況異常，也不一定能立即找出背後原因。

長期投入慢性傷口與組織修復研究的台大醫院外科部整形外科主任、台大醫學院副院長鄭乃禎，近年將研究焦點放在生物膜（Biofilm）對傷口癒合的影響。由其團隊開發的「傷口生物膜檢測套組」，因協助醫師更快速辨識慢性傷口中的生物膜問題，獲得國家新創獎「臨床新創獎」肯定。只是對鄭乃禎而言，獲獎並非終點，更重要的是讓研究真正回到臨床現場，幫助醫師看見過去看不見的問題。

看不見的敵人，藏在傷口深處

多數人認為傷口感染常會出現紅、腫、熱、痛，也知道若傷口出現紅腫範圍擴大、疼痛加劇、流膿、異味、發燒，應儘早就醫。但在臨床上，許多久治不癒的慢性傷口卻不是如此。

鄭乃禎觀察，許多患者的血糖控制已改善、血流循環也獲得治療，傷口卻仍遲遲無法癒合。這些傷口表面看似平靜，實際上卻長期處於低度發炎狀態，而背後的原因，往往與生物膜有關。

所謂生物膜，可以想像成細菌聚集後形成的一層黏稠保護膜。細菌躲在裡面，較不容易被白血球或抗菌藥物清除；即使接受治療，仍可能持續存活並反覆增生。更棘手的是，它未必呈現典型感染症狀，因此容易被長期忽略。

傷口醫學新趨勢，從感染導向到生物膜導向

過去的傷口治療，多聚焦於控制感染與促進癒合。然而隨著研究累積，國際傷口醫學界逐漸形成共識：許多慢性傷口真正需要處理的，是生物膜。

近幾年臨床逐漸建立「生物膜導向傷口照護」（Biofilm-based Wound Care, BBWC）的概念。

這套治療策略的核心，是先透過清創移除生物膜，再搭配能抑制生物膜重新形成的敷料或藥劑控制細菌重新聚集，並持續追蹤與評估傷口變化。必要時，還需要多次清創、調整敷料或改變治療方式，直到傷口重新回到正常癒合軌道。

鄭乃禎指出，生物膜並不一定只存在於傷口表面，也可能向深層組織延伸，因此單靠外用藥物有時無法完全處理。這也是為什麼慢性傷口的治療往往比想像中更加複雜。

最大的挑戰，不只是治療，而是先看見問題

雖然生物膜的重要性已獲得廣泛認可，但臨床一直面臨同一個難題：醫師如何知道傷口裡真的有生物膜？

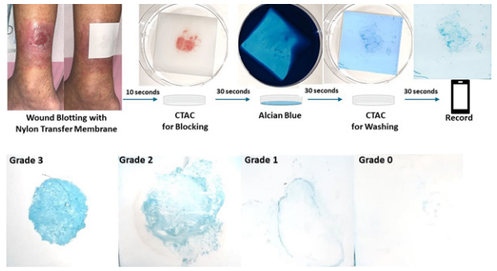
長期以來，醫師多半只能依據經驗判斷。例如傷口久治不癒、反覆發炎，便推測可能存在生物膜。若要進一步確認，則需透過電子顯微鏡或特殊免疫染色等工具，不僅成本高昂，也難以在一般門診應用。

「很多時候，我們是在治療沒有效果之後，才開始懷疑是不是生物膜造成的。」鄭乃禎坦言。

這種不確定性，不只影響醫師判斷，也可能延誤病人的治療時機。

從研究室走向臨床現場：讓生物膜被快速辨識

正因為看見這項臨床痛點，鄭乃禎教授團隊結合台大醫院整形外科與清華大學生物醫學工程研究所的研究能量，投入傷口生物膜檢測技術開發。然而，從研究成果到臨床工具之間，仍有一段漫長的距離。為了讓技術真正落地，團隊與明基材料合作推動技術轉譯，結合其在醫療材料、製造與法規驗證上的經驗，於 2023 年完成技術移轉，讓這項檢測技術有機會真正應用於臨床照護。



照片出處：https://innoaward.taiwan-healthcare.org/award_detail.php?REFDOCID=0sq2hwdurc1l9zbd

這項技術最大的特色，在於將原本屬於研究室等級的檢測概念，轉化成可於臨床現場快速操作的工具。

透過特製試片接觸傷口表面，再經過染色分析，短短數分鐘內即可協助判斷是否存在生物膜，甚至進一步了解分布位置與嚴重程度。檢測結果仍需搭配醫師對傷口外觀、病史與整體狀況的判斷。

對醫師而言，這不只是多了一項檢驗工具，而是讓治療決策有了更客觀的依據。例如在判斷是否需要清創、是否需要使用抗生物膜敷料時，醫師能更早做出治療決策；治療後，也能再次檢測，確認處理是否有效，而不必只靠肉眼與經驗判斷。

傷口醫學的下一步：邁向精準照護

從整形外科醫師到醫學研究者，鄭乃禎長期關注的並非單一產品，而是如何讓傷口照護更精準。

他認為，未來傷口醫學的發展方向，將從「看到傷口」進一步走向「理解傷口」。包括智慧敷料、即時感測、生物訊號監測，以及結合細胞治療與外泌體等新技術，都可能改變未來的治療模式。

但在所有創新之前，最重要的一步仍是辨識問題。因為，唯有看見生物膜，才能真正理解為什麼傷口好不了；也唯有理解傷口，治療才能從經驗走向精準。