CNM TECHNOLOGIES

Carbon Nanomembrane: Pioneering a New Class of Material

"Change is the only constant."

What one considers to be the best of the breed today, can soon be replaced by something more efficient tomorrow. The most recent instance of this is Carbon nanomembrane (CNM)—a new class of molecular thin polymer-like material—that is now challenging the status quo of Graphene as the "supermaterial" in the manufacturing sector. Developed by Prof. Armin Gölzhäuser, Co-Founder of CNM Technologies, CNM is a step up from CVD graphene (atomic-thin graphite) in many aspects. In terms of its production process, for instance, CVD graphene often demands a specific growth substrate (like copper), while the final application of the sheet graphene is on another surface. This requires a transfer of the nanometer-thin layer, thereby putting a lot of stress on the layer and making it hard to scale.

On the other hand, as shown by Dr Schnieders, the CEO of CNM Technologies, and his team, it is possible to produce a free-standing nanometer-thin active layer of a CNM supported by a polymer film with micron-sized pores. These layers can be produced on a continuous polymer film. Subsequently, the polymer support can be made porous to mitigate the need for transferring the CNM on the porous support.

Such findings have helped Dr Schnieders to set a firm footing in the advanced materials realm with his company CNM Technologies—the sole supplier of Carbon nanomembranes. CNM Technologies holds a broad IP portfolio (15 families of patents and patent applications) protecting the material, handling and applications of CNMs. "Our goal is to develop new applications based on CNMs, together with partners in industry and research," comments Dr Schnieders.

> **"Our goal is to develop new applications based on CNMs, together with partners in industry and research"**

The CEO further highlights that CNMs are also very flexible in growth substrates. Virtually all metals and their oxides, silicon-based surfaces, other semiconductors, glass, and even polymers can be used as a growth substrate. And, then, the experts at CNM Technologies can tune the material for its more specific applications. Dr Schnieders adds, “We are also developing different concepts for manufacturing and implementing CNMs.” To this extent, CNM Technologies has created a proprietary toolbox that includes different manufacturing steps, suitable for both mass production of large-area separation membranes and free-standing CNMs for complementary metal-oxide semiconductors in sensors or integrated circuits.

At this juncture, the early success of CNMs is but the herald of overarching benefits that could be availed across multiple domains such as membrane technology, biological and chemical sensor technology, medicine, energy, and flexible electronics. The semiconductor manufacturing industry, in particular, is now evaluating CNMs for developing pellicles used in semiconductor lithography. These free-standing protecting films hold back dust particles and save the circuit from any damage during extreme ultraviolet (EUV) lithography. Other potential applications are in flexible electronics, battery technology, and more. “We have a network of scientific groups from where we can recruit experts for specific tasks,” comments Dr Schnieders.

What’s more? CNM Technologies is currently focused on developing an in-house CNM-based water filtration system. Schnieders explains that CNMs are highly permeable for water while filtering everything else out, e.g. salt, small organic molecules like urea or ethanol, and heavy metals. CNM Technologies has already succeeded in developing a composite membrane concept with the nanometer-thin CNM as the active layer. This CNM-based water filtration system can be potentially used in the provision of ultrapure water, cold concentration of watery solutions, and in the circular economy (recovery of water from waste streams). Besides, the applicability of CNM-composite membranes can extend more as these can also be developed into size-selective gas separation and affinity membranes. Realising these potentials, the European Commission has recently awarded a Future Emerging Technology (FET) Open project for further developing water separation with CNMs. As part of this project, the company will be the central piece of a consortium comprising eight institutions that spans the whole “value chain” of water treatment. CNM Technologies is currently using the fund to sponsor a pilot project towards the same, implementing various results from basic research in composite membranes and supplying process developers with CNMs for functional demonstrations.

With such a promising future ahead, CNM Technologies has now pulled out all the stops towards developing innovative products and transforming the world for the better with its molecular membrane solutions. Moreover, having built strong relationships with the University of Bielefeld and the University of Jena, CNM Technologies is inarguably driving advanced material innovation and research effectively towards a more sustainable future.

ISSN 2644-2493

MANUFACTURING TECHNOLOGY INSIGHTS

JULY - 2020

MANUFACTURINGTECHINSIGHTS.COM