2026 Helmholtz – OCPC – Programme

for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project:

Bioinspired Intelligent Ionic Skin Materials

Helmholtz Centre and/or institute:

Forschungszentrum Jülich

Project leader:

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Description of the project (max. 1 page)**:**

The rapid advancement of flexible electronics and wearable technologies has placed increasing demands on next-generation bioinspired intelligent materials. A key frontier challenge in materials science is how to create integrated systems that, like natural skin, simultaneously exhibit **exceptional elasticity, adaptive mechanical responses, intrinsic self-healing capability, and multimodal sensing functions**.

Our research is dedicated to addressing this challenge at the interface of polymer science, soft-matter physics, and bioinspired materials design. Building on the laboratory's recent breakthroughs in **bioinspired polymers and dynamic network architectures**, this project focuses on the development of **novel ionic skin materials**. Through a carefully designed **bioinspired double-network strategy**, these materials integrate high elasticity, skin-like strain-stiffening behavior, and efficient self-healing, providing an ideal materials platform for next-generation **high-performance, biocompatible wearable sensors and human–machine interfaces**.

A distinctive strength of this project lies in its emphasis on uncovering the **fundamental origins of material performance**, rather than material synthesis alone. Advanced characterization using **X-ray scattering and neutron scattering techniques** will be employed to probe material structures across multiple length scales. Postdoctoral researchers will systematically apply **small- and wide-angle X-ray scattering (SAXS/WAXS)** to investigate nanoscale and molecular-level structural evolution during mechanical deformation. In parallel, **neutron scattering**, with its unique sensitivity to light elements—particularly hydrogen—will be used to noninvasively elucidate key scientific questions such as internal hydration environments and hydrogen-bond network dynamics. Together, these approaches will enable the establishment of a comprehensive **structure–property–function relationship**, linking molecular design, mesoscopic organization, and macroscopic performance.

Description of existing or sought Chinese collaboration partner institute (max. half page)**:**

Donghua University is a comprehensive research university in Shanghai with strong materials science and polymer research. Its Materials Science discipline ranks among the top globally in ESI, and it is nationally recognized for polymer materials, consistently contributing high-impact research and international collaborations in polymer science and engineering.

The Center for Advanced Low-dimension Materials (CALM) at Donghua University is a flagship research institute established in 2015. Led by Professor Stephen Z. D. Cheng, a Member of the US National Academy of Engineering, the center focuses on pioneering the science of next-generation low-dimensional materials. Its research pursues the ultimate limits of material properties, targeting applications in critical fields such as smart textiles, environmental technology, and Intelligent Polymeric Damping Materials. The center is structured to foster international collaboration and advance global material innovation.

Required qualification of the postdoc:

- PhD in Chemisty, Materials science or soft-matter physics
- Experience with Synthesis of polymer materials and conventional property characterization methods
- Additional skills in x ray/neutron scattering method (not mandatory)
- Fluent spoken and written English