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EDITORIAL

Stephan Förster: on the occasion of his 60th birthday

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Stephan Förster began his scientific career at the University of Mainz where he studied from 1983 to 1989. Already as a student, he was captivated by the physics of polymers and colloids. His early influences included an exchange program in Canada, where he collaborated with Mitchell A. Winnik at the University of Toronto. This opportunity, together with his diploma research under Gerhard Wegner at the Max Planck Institute (MPI) for Polymer Research in Mainz, helped him to explore polymer self-assembly and pioneering experimental techniques.

For his doctoral studies, Stephan joined Manfred Schmidt's group at the MPI for Polymer Research in Mainz and earned his Ph.D. in 1992. During this time, he made important contributions to our understanding of polyelectrolytes and polymers in solution. Using static and dynamic light scattering, he studied how polymer charge density, molecular weight, and salt influence the solution structure and phase behavior. His early, pioneering publications from this period showed a careful balance of experiment and theory, characteristic traits that defined Stephan's entire scientific career.

Immediately after earning his Ph.D., Stephan expanded his international experience. In 1992, he became a postdoctoral fellow with Frank S. Bates at the University of Minnesota. In Minneapolis, Stephan immersed himself in advanced research on block copolymer phase behavior. A key study from this time addressed the behavior of polyisoprene–polystyrene diblock copolymers near their order-disorder transition. Additionally, he helped identify two new microstructured polymer phases, including a bicontinuous cubic "gyroid" phase of *Ia3d* symmetry, which appears between the classic cylinder and lamellar phase regions [1]. These discoveries, made through electron microscopy and small-angle X-ray/neutron scattering, broadened the traditional phase diagram of block copolymers and highlighted Stephan's deep understanding of self-assembly. His collaboration with Bates not only yielded impactful results but also built international relationships – he recognized the importance of cross-continental teamwork, a practice he continued throughout his career.

Returning to Germany in 1993, Stephan joined the MPI for Colloids and Interfaces in Golm as a staff scientist under Markus Antonietti. He shifted his focus to amphiphilic block copolymers and their self-assembly in solution. Stephan became a leading researcher in exploring how block copolymers could form micelles, vesicles, and other supramolecular structures similar to surfactant systems.

By the late 1990s, Stephan had established himself as a leading young researcher in polymer science. His habilitation at the University of Potsdam in 1999 marked this milestone in his career, supported by a series of influential publications. Notably, he co-authored a review in *Advanced Materials* (1998) that discussed amphiphilic block copolymers as tools for controlled nanostructured hybrids, highlighting their role in stabilizing interfaces and templating nanoparticles [2]. This topic shaped Stephan's later research: linking soft matter and inorganic materials.

In 2000, Stephan Förster started the next chapter of his career by accepting a faculty position at the University of Hamburg. As a full professor, he led the Institute of Physical Chemistry and quickly made it a center for soft matter and colloid science. During this time, Stephan expanded his research to include polymer-based hybrid nanomaterials and advanced characterization methods. Moving to Hamburg also brought him closer to researchers like Horst Weller. Stephan took this chance to collaborate across

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disciplines—combining the self-assembling polymer systems he knew well with the semiconductor and metal nanocrystals developed by Weller's group. In a *Science* paper from 2010, they demonstrated that colloidal PbS nanocrystals can self-assemble into perfectly coherent single-crystalline sheets measuring micrometers across [3]. This breakthrough showed how controlling ligand interactions and assembly conditions could create new nanoparticle superstructures. Throughout the 2000s, Stephan made many other significant contributions to a broad scientific community. His works on polymersomes and vesicles expanded the concept of lipid self-assembly to amphiphilic polymers. This work helped to establish polymersomes as a versatile platform in materials science. Likewise, Stephan pushed the limits of block copolymer self-organization in bulk and thin films. He explored how block copolymers could template mesoporous materials and nanoparticle arrays, which set the ground for what is now called "soft templating" methods in nanotechnology.

Stephan's interest in exploring the structure of mesoscale materials also led him to advanced analytical tools such as small-angle X-ray and neutron scattering, as well as the development of new data analysis methods. These contributions have significantly benefited the community, allowing researchers around the world to easily extract quantitative information from scattering data, for example, through the open-source software *Scatter*, developed by Stephan and his colleagues [4]. It is no surprise that, thanks to these efforts, Stephan Förster is now recognized not only as an expert in polymer chemistry and colloids but also as a leader in neutron and X-ray scattering for soft matter.

In 2010, Stephan Förster joined the University of Bayreuth as a full professor of Physical Chemistry. He continued his fundamental research on polymer self-assembly and hybrid materials but also developed an interest in microfluidics and real-time observation of soft matter processes. For example, his team created microfluidic techniques to align and manipulate colloidal particles under flow. Stephan and his colleagues made a surprising discovery that anisotropic colloidal particles can align *perpendicular* to the flow direction when passing through narrow channels—contradicting the common assumption of parallel alignment [5].

It was also in Bayreuth that Stephan explored the fascinating world of quasicrystals in soft matter systems. Along with a talented team, he discovered that simple block copolymer micelles in water can organize into quasicrystalline patterns with 12-fold and even 18-fold rotational symmetry [6]. It confirmed theoretical predictions that quasicrystalline order can be thermodynamically stable in certain soft systems. Stephan's ability to identify and pursue this discovery shows his sharp scientific intuition and willingness to go beyond traditional "crystal" order in self-assembly studies.

Over the years, Stephan Förster has become known not just as a prolific scientist but also as a mentor and community leader. He has consistently been generous in supporting young researchers and helping them thrive. Many who worked with him in Bayreuth have since built successful independent careers. Stephan has a remarkable talent for recognizing promising young scientists, nurturing their ideas, and often collaborating with them as peers. Colleagues in Bayreuth and beyond frequently remark on his collegiality and his enthusiasm for sharing knowledge.

In 2017, Stephan took on a new role that perfectly matches his expertise and vision: he became director of the Institute of Complex Systems (JCNS-1, Neutrons and Soft Matter) at Forschungszentrum Jülich (FZJ). In this role, he oversees one of Europe's top centers for soft matter research and neutron scattering. His appointment highlights his reputation as a scientist who connects fundamental research with large-scale facility science. At FZJ, Stephan has continued to explore new frontiers.

One area where he has made notable progress is in the kinetics of nanoparticle and crystal growth through non-classical pathways. He also reexamines fundamental principles of polymer physics with a fresh outlook. For example, he demonstrated that a classic thermoresponsive polymer (PNIPAM) can exhibit bistability and memory effects due to hysteresis in its phase transition [7]. By leveraging this hysteresis, his team demonstrated a form of reversible information storage in a polymer film, essentially using polymer swelling and deswelling as a two-state memory bit. This innovative repurposing of soft matter phenomena for potential device applications showcases Stephan's creative thinking. It connects to his long-standing interest in how responsive polymer systems can be used in new ways—a concept rooted in his early work on polyelectrolytes and block copolymers.

Furthermore, under Stephan's leadership, the Jülich Institute has become a hub for advanced methodological development. He has played a key role in improving neutron scattering techniques and the theoretical tools needed to interpret them. It is fitting that Stephan, a power user of scattering, also contributes to the mathematical and computational foundations of the field. His unique combination of hands-on experimentation and theory/software development has made him a leader in soft matter characterization.

As we celebrate Professor Stephan Förster's 60th birthday, we recognize a career that is as diverse as it is distinguished. Stephan's contributions cover polymer chemistry and physics, polymer self-assembly phase behavior, colloids and nanostructured hybrid materials, as well as the development of small-angle scattering techniques for soft matter research. Few scientists manage to make a mark in so many fields, and even fewer do so with the level of

excellence and impact that Stephan has achieved. His work has led to new materials and greater understanding: from discovering *micellar quasicrystals* and *polymer vesicles* beyond traditional surfactants, to creating *transparent nanoparticle composites* and *2D nanocrystal superlattices*, as well as developing *microfluidic methods* that offer real-time insights into self-assembly. Each of these advances was driven by his clear vision of what important questions are and how to answer them with both rigor and creativity.

Equally important, Stephan Förster has been a cornerstone of the scientific community. He has collaborated with and learned from some of the best in the field. Those who have worked with Stephan often speak of his passion for science and his sharp intellect, combined with a down-to-earth demeanor that makes him a pleasure to work with. One of Stephan's greatest legacies may be the generation of researchers he has mentored. His former students and postdocs carry forward his passion for soft matter science. They, in turn, are building on the foundation he helped establish—whether through academic positions, innovative start-ups, or industrial R&D.

In celebrating Stephan Förster's 60th birthday, we not only honor his past achievements but also look forward to the future contributions we know he will make. Happy Birthday, Stephan, and thank you for showing us the beauty of self-assembled worlds, for breaking down barriers between disciplines, and for building a community that is stronger because of your presence. May the coming years be as lively and productive as the remarkable career we celebrate today.

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Declarations

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