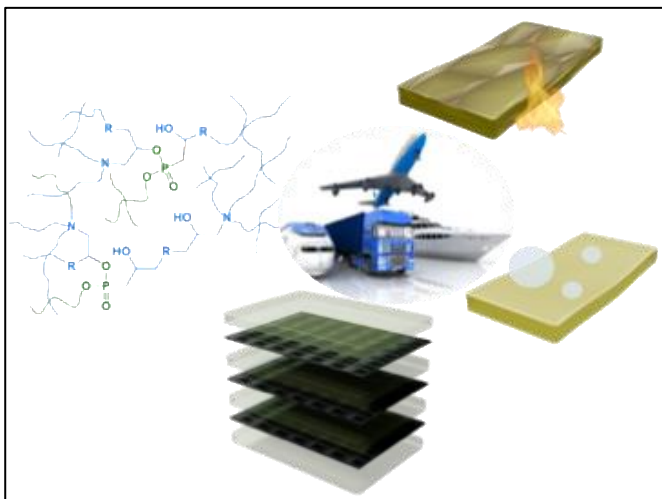


PhD course - Polymers to meet today's and future requirements

Lecturer: Dr. Sabyasachi Gaan (Empa)

Course Summary: This PhD course explores the forefront of polymer science and engineering, focusing on how next-generation materials can meet contemporary industrial demands and requirements. The curriculum bridges polymer chemistry, physics, and processing with sustainability, performance, and safety, showcasing how molecular innovation translates into real-world impact.



Key themes include sustainable polymer design, self-healing and reprocessable systems, flame retardant materials, hybrid organic/inorganic nanocomposites, and aerospace applications. A major focus is given

to covalent adaptable networks, i.e., a new class of dynamic covalent polymers combining the robustness of thermosets with the reprocessability of thermoplastics. Students will explore vitrimer chemistry, dynamic bond exchange mechanisms (e.g., associative), and their potential in circular economy models, flame retardancy, advanced composites, and high-performance structural components. Besides, the course emphasizes flame retardant strategies, functionalities, and how advanced polymeric materials, and vitrimers can contribute to lightweight, durable, and repairable materials, particularly valuable in transportation sectors.

Through lectures and research-driven discussions, participants will critically assess the pathways from molecular design to societal relevance, connecting theoretical breakthroughs to the discussion of practical applications in chemistry, recyclability, and flame retardancy.

Learning Outcomes - By the end of the course, participants will know more about:

- Design, synthesis, and development of novel and sustainable polymers
- Their functionalization, including flame retardancy and durability

The focus of these polymers application will be building and transportation industries

Target Audience: PhD candidates in Industrial Product and Process Engineering, Industrial Engineering, and Chemical Sciences, and researchers in polymer science, materials science, chemistry, or related field, aiming to connect cutting-edge polymer research to global technological challenges.

Duration: 12 h (2 CFU)

Dates: Tuesday 9th – Monday 15th December 2025

Final exam:

(20%) - Class attendance, including interaction with short question test

(30%) - Writing a report (3 pages) about technologies related to the course's contents

(50%) - Oral group presentation with lectures

Registration: please complete this [form](#).