ReBond Newsletter Capri 2025

Summer School on Polymeric Networks for Sustainable Developments

ReBond MSCA DOCTORAL NETWORK

Funded by the European Union

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SUMMARY

1. Introduction

The Summer School at a Glance

This July, Anacapri hosted the **Summer School on Polymeric Networks for Sustainable Development**, bringing together students and researchers from academia and industry. The program explored the latest advances in reprocessable polymeric networks which are dynamic systems with temporary crosslinks that can be recycled and repurposed, such as vitrimers and associating networks. Lectures and discussions covered experimental, theoretical, and computational approaches, along with applications in industry and the design of functional polymer gels. Participants also had the opportunity to share their own research during lively poster sessions.



The Location

Our summer school took place in Anacapri, a village set on the heights of the island of Capri, known for its narrow whitewashed streets and wide sea views. Participants experienced the calm atmosphere of Anacapri alongside the cultural richness of Capri, from the Villa San Michele and Monte Solaro to the historic center of Capri town and the famous Blue Grotto. This combination of study and local heritage provided a stimulating environment for learning and exchange in the heart of the Mediterranean.



1. Introduction

The Organizing Committee

The summer school was organized by **Prof. Jian Ping Gong** (Hokkaido University, Japan), **Prof. Giovanni Ianniruberto** (University of Naples, Italy), **Prof. Evelyne van Ruymbeke** (UCLouvain, Belgium), and **Prof. Dimitris Vlassopoulos** (FORTH-Crete, Greece).

2. Program Highlights

WELCOME RECEPTION

6 July, 2025 - Hotel San Michele

The summer school kicked off with a welcoming dinner prepared by the organizers at the Hotel San Michele during one of Capri's beautiful sunsets. Delectable local Italian cuisines were served with a much needed avenue to get to know other participants and lecturers.

2. Program Highlights

LECTURES AND KEY TOPICS

7-11 July, 2025 - Centro Multimediale Mario Cacace

A total of 14 professors from six countries (Italy, Japan, United States, China, Belgium, and Saudi Arabia) delivered lectures covering a wide range of topics, including the theory, rheology, dynamics, structural analysis, molecular design, and molecular dynamics (MD) simulations of various polymers (solutions, melts, and networks). Further informations can be found on the official ReBond website

7th July

The day began with **Nikolaos Hadjichristidis** (KAUST University) presenting on the synthesis of dynamic covalent macromolecular architectures, from linear and star-shaped polymers to vitrimer networks, illustrating how this chemistry enables advanced material design.

Building on this, **Filip Du Prez** (Ghent University) explored how dynamic covalent chemistry can support the industrial adoption of reprocessable thermosets.

Ralph Colby (Penn State University) then offered insights into the physics of polymer networks, highlighting the principles behind their mechanical and dynamic behavior.

The session concluded with **Xiang Li** (Hokkaido University), who showcased methods for structural analysis and tools to probe network organization.

2. Program Highlights

8th July

Filip Du Prez (Ghent University) opened with a lecture on healable coatings and on-demand debondable adhesives derived from covalent adaptable networks, illustrating how reversible bonds enable materials that are both robust and reconfigurable.

Michael Rubinstein (Duke University) followed with insights into the thermodynamics and dynamics of hetero-associative polymer solutions and gels, shedding light on the molecular interactions that define their complex behavior.

The session ended with **Emanuela Del Gado** (Georgetown University), who discussed the statistical mechanics of reversible, self-organized networks, linking transient bonding mechanisms to the emergent properties of soft materials.

9th July

Thomas O'Connor (Carnegie Mellon University) opened with simulations of associative polymer networks far from equilibrium, exploring their complex dynamic behavior.

Ralph Colby (Penn State University) discussed the dynamics of ionomer melts and reversible networks, while Hiroshi Watanabe (Kyoto University) examined the viscoelastic and dielectric properties of associating polymers.

The session concluded with **Mario Minale** (UniCampania), who presented on the dynamics of immiscible polymer blends, highlighting the factors governing phase behavior and relaxation processes.

2. Program Highlights

10th July

Tasuku Nakajima (Hokkaido University) opened with a lecture on polymer gels: fundamental properties and their dynamics, exploring the molecular mechanisms that govern their behavior.

Michael Rubenstein (Duke University) followed with the art of network design, highlighting strategies to tailor polymer networks for desired properties.

The session concluded with **Ralm Ricarte** (Florida State University), who presented on the static and dynamic properties of vitrimers, emphasizing their unique combination of adaptability and stability.

11th July

Quan Chen (Changchun Institute of Applied Chemistry) opened the session with a lecture on vitrimer viscoelasticity, exploring how these dynamic networks respond under stress.

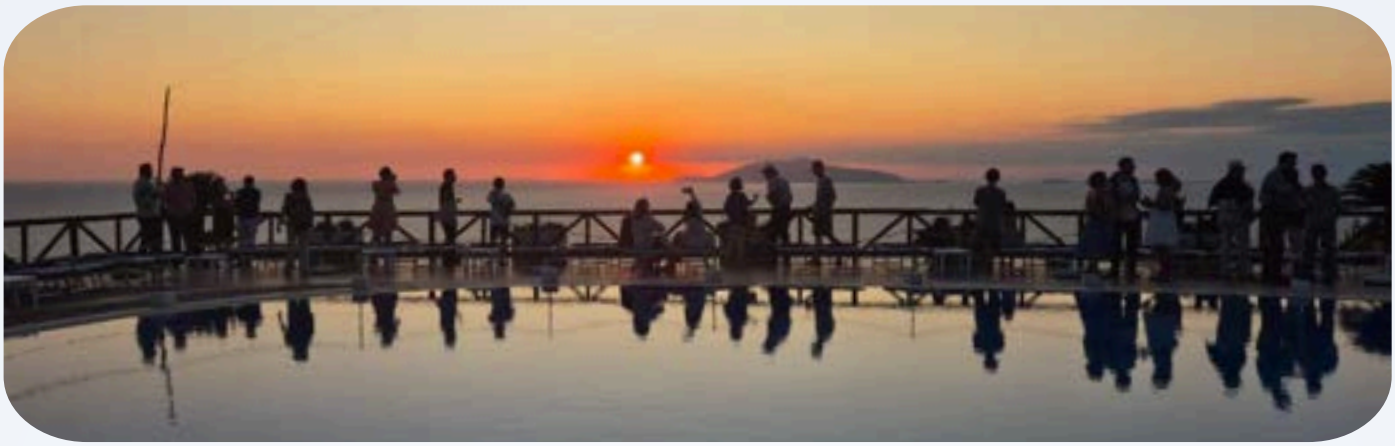
Fardin Kabaz (University of Akron) followed with computational rheology of vitrimers, demonstrating how molecular dynamics simulations can be used to predict macroscopic flow behavior.

The session concluded with **Sunat Kumar** (Columbia University), who discussed (micro)phase separation and dynamics in vitrimers, highlighting how structural organization influences their mechanical properties.

2. Program Highlights

SCHOOL DINNER

10 July, 2025 - Da Gelsomina - Ristorante



Once again, participants, lecturers, organizers and some of their family members were given the chance to socialize and relax over dinner while overlooking the breath-taking views of the Mediterranean sea.

The ReBond DCs took advantage of this moment to show gratitude towards the organizers of this event by presenting some simple local gifts.

2. Program Highlights

POSTER SESSIONS

The poster sessions provided participants with an excellent opportunity to showcase their research, receive feedback, and engage in lively discussions across a wide range of topics, from organic synthesis and material characterization to mechanical testing, modeling, and simulations. These sessions highlighted the creativity, diversity, and interdisciplinary nature of the participants' work.

The first session focused on polymeric materials, featuring innovative studies on polymer synthesis and design for industrial and biomedical applications, advanced rheological and nanostructural characterization, as well as novel polymeric gels, porous materials, and adaptable dynamic networks.

The second session centered on vitrimers, giving PhD students from the ReBond doctoral network a platform to present their latest findings and share new insights into this rapidly evolving field.

The full list of authors and abstracts is available on the official ReBond project website.

2. Program Highlights

INDUSTRIAL WORKSHOPS

The industrial workshop created a dynamic space where academia and industry collaborated to tackle real-world challenges using dynamic polymer networks, particularly vitrimers. Participants worked in teams to propose and defend solutions, emphasizing creativity, problem-solving, and practical applications.

Olivier Lhost and **Philippe Reutenauer** opened with a case on packaging, showing how vitrimers can improve performance during use and enhance recyclability at the end of life. Discussions included integrating vitrimer networks with PET to leverage its processability and widespread use in food packaging, exploring sustainable solutions without compromising material properties.

Salvatore Coppola, then, presented a case on elastomers, prompting teams to consider the effects of introducing dynamic crosslinkers into permanently crosslinked systems like vulcanized rubber. Teams explored potential benefits for static and dynamic applications, impacts on processability, and industrial cost–benefit considerations.

Milad Golkaram added a session on epoxy adhesives and the circular economy, highlighting the role of dynamic bonds in innovation. Teams then worked together to develop short ideas, which they presented to the audience.

The workshop fostered collaboration, interdisciplinary thinking, and a deeper understanding of how cutting-edge polymer science can be applied to practical industrial challenges.

3.Conclusions

As PhD students of the ReBond Doctoral Network, we experienced the Summer School as an inspiring and truly formative moment. It was not only an opportunity to expand our scientific knowledge, but also a chance to exchange ideas, build collaborations, and strengthen the sense of community within our network.

We are deeply grateful to our sponsors for making this event possible, to the organizing committee for their dedication, and to all speakers and participants for contributing their expertise, enthusiasm, and curiosity.

4. Acknoweldgments

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As we continue our journey as young researchers, we look forward to sharing the next steps of the ReBond project with you.
Stay tuned for updates!