DIPARTIMENTO DI SCIENZE CHIMICHE

UNIVERSITÀ DEGLI STUDI DI PADOVA

13 Aprile 2023, ore 16.00
Aula F, Dipartimento di Scienze Chimiche

Seminario

"Combined methods in polymer melt rheology: Rheo-NMR, Rheo-IR, Rheo-Dielectric spectroscopy"

Prof. Dr. Manfred Wilhelm
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Molecular understanding of mechanical properties over a broad length and time scale is crucial to develop advanced materials. Our research aims to design unique combined rheometer setups that can monitor in-situ molecular observables, such as molecular dynamics or chemical functional groups, that are directly correlated to the macroscopic mechanical responses. These combined experimental setups overcome the experimental challenges associated with offline measurements and facilitate the understanding of structure-property relationships. We developed a unique combination of rheology and low-field time domain ^{1}H NMR (TD-NMR) by implementing a compact 25 MHz NMR magnet into a DHR-3/ARES-G2 rheometer. This Rheo-NMR device can quantify segmental motion of polymer chains via transverse relaxation times (T_2) while simultaneously performing advanced rheological protocols. The Rheo-NMR device was used in hydrogel synthesis to study the impact of crosslinker concentration (*DC*) during the aqueous crosslinking copolymerization of acrylic acid and *N*,*N*'-methylenebis(acrylamide). A further unique rheometer combination to study molecular dynamics is Rheo-BDS, broadband dielectrics spectroscopy. By using anionic polymerization of isoprene derivatives we could cover both via dielectric spectroscopy and rheology applying time temperature superposition more than 30 decades in frequency space. To correlate chemical structure formation during polymerization and the in-situ correlation towards mechanical properties, IR spectroscopy was in-situ correlated to mechanical characterization during hydrogel formation. Up to 50 % of covalent bond formation did not increase the mechanical properties. In the later stage of the chemical reaction a scaling exponent of 10 was determined for G' as a function of chemical bond formation.

Prof.ssa Silvia Gross (DiSC)

Il Direttore del Dipartimento di Scienze Chimiche
Prof. Michele Maggini