PHOTORHEOLOGY: A VERSATILE TOOL TO UNRAVEL PHOTOPOLYMERIZATION PROCESSES

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Photopolymerizations most frequently are very fast reactions of multifunctional monomers. Hence, deducing the effects of different components and conditions on final properties of formed insoluble networks is challenging. Together with Anton Paar GmbH, an infrared spectrometer was coupled to a photorheometer[1]. With this tool, a broad spectrum of different photopolymerizable formulations was characterized thoroughly by combination of the rheological with the chemical information.
These formulations include classical (meth)acrylic[2] and epoxy system[3] but also other ring-opening[4] and thiol-ene[5] click systems up to highly complex systems of, e.g., modified biopolymers used as precursors for hydrogels6 for biofabrication applications[7].

[1] C. Gorsche, R. Harikrishna, S. Baudis et al. Anal. Chem. 89, 4958 (2017). https://doi.org/10.1021/acs.analchem.7b00272
[2] B. Dellago, A. Ricke, T. Geyer et al. Eur. Polym. J. 154 (2021). https://doi.org/10.1016/j.eurpolymj.2021.110536
[3] A.D. Tran, T. Koch, R. Liska et al. Monatsh Chem 152, 151 (2021). https://doi.org/10.1007/s00706-020-02726-y
[4] Y. Mete, K. Seidler, C. Gorsche et al. Polym Int 71, 1062 (2022). https://doi.org/10.1002/pi.6430
[5] C. Hofstetter, S. Orman, S. Baudis, J. Stampfl. Add. Manuf. 24, 166 (2018). https://doi.org/10.1016/j.addma.2018.09.025
[6] L. Rebers, R. Reichsöllner, S. Regett et al. Sci Rep 11, 3256 (2021). https://doi.org/10.1038/s41598-021-82393-z
[7] E. Zerobin, M. Markovic, Z. Tomášiková et al. J. Polym. Sci. 58, 1288 (2020). https://doi.org/10.1002/pol.20200073

SONORHEOLOGY: A NOVEL SET-UP FOR INVESTIGATION OF ULTRASOUND-TRIGGERED REACTIONS

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Ultrasound (US) are mechanical waves with the frequency higher than 20 kHz, above the human audible region. US is frequently used in material science and medicine as diagnostic method. However, it can also trigger changes in material properties, or induce chemical reactions within materials.
To study ultrasound-triggered changes in mechanical properties of studied materials, we here introduce a rheometer combined with an US unit built into the bottom plate to stimulate the sample during rheology measurements. The US unit consists of a US transducer that is connected with a waveform generator and a power amplifier. Additionally, a special PMMA-based stamp is used during ultrasonication to minimize US wave reflexion. This custom-made set-up was developed in cooperation with Anton Paar GmbH.
The used US unit mimics conditions relevant for medical applications. More specifically, pulsed US with a frequency of 1 MHz, an amplitude up to 200 mV_{RMS} and a duty cycle of around 20 % were selected in our case. These conditions were picked as they are not harmful to the human body. This is important for research that focuses on medical applications, as harsh US conditions would damage affected tissue.

Different sample types were tested, from liquid formulations with low viscosity to relatively stiff hydrogels. Depending on the type of interaction with US, stiffening or softening of the material can be observed during US triggering. These changes can be permanent, or the material returns to its original state. In both cases the in-situ rheological measurements during ultrasonication are a suitable tool for monitoring of the mechanical changes in the material.

PROGRAM

1ST ANNUAL CONFERENCE
18TH NOVEMBER 2022

SPEAKER	ABSTRACT TITLE
U. WINDBERGER K. SCHNEIDER	Blood clot phenotyping by LAOStress Rheological Characterization of Placental Extracellular Matrix Hydrogels
R. CERBINO N. KALAFATAKIS	Quantitative rheo-microscopy of soft-matter Unexpected stress relaxation of low functionality star-shaped polymers in the low frequency regime
S. BAUDIS	Photorheology: A Versatile Tool to Unravel Photopolymerization Processes
C. HASLINGER	Sonorheology: A Novel Set-Up for Investigation of Ultrasound-Triggered Reactions
D. BENDER	Food rheology and its importance in plant-based food processing
R.M. EDER	Potential of bio-based friction modifiers for safe use in food-grade lubrication
G. BRENN	The characteristic equation of oscillating viscoelastic drops
L. NOIREZ	Revisiting Rheology to Access Hidden Elasticity in Liquids and Complex Fluids
V. KLANG	Spruce balm-based dermal formulations: flow properties and storage stability
M. EDLER	Special Rheological Applications
K. ELSAYAD	All-optical measurements of blood plasma viscosity in COVID-19 patient samples
B. PICHLER	Hourly-Repeated Three-Minutes Creep Tests of Cementitious Materials at Early Ages
K. HOFER	Chemo-mechanical anaylsis of bitumen
A. ROBISSON	Heterogenous flows in sheared cement suspensions
L. NASSERI	Rheokinetic investigation on the thermal cure of adhesives

	SPEAKER	TIMELINE	CHAIR
9^{00}	WELCOME		
$9^{15} - 10^{30}$	U. Windberger K. Schneider R. Cerbino N. Kalafatakis	$9^{15} - 9^{30}$ $9^{30} - 9^{50}$ $9^{50} - 10^{10}$ $10^{10} - 10^{30}$	U. Windberger
$10^{30} - 11^{00}$ COFFEE BREAK VISIT TO THE INDUSTRIAL EXHIBITION			
$11^{00} - 12^{30}$	S. Baudis C. Haslinger D. Bender R.M. Eder	$11^{00} - 11^{20}$ $11^{20} - 11^{40}$ $11^{40} - 12^{00}$ $12^{00} - 12^{20}$	Ph. Fuhrmann
$12^{20} - 13^{20}$ LUNCH			
$13^{20} - 15^{00}$	G. Brenn L. Noirez V. Klang M. Edler K. Elsayad	$13^{20} - 13^{40}$ $13^{40} - 14^{00}$ $14^{00} - 14^{20}$ $14^{20} - 14^{40}$ $14^{40} - 15^{00}$	S. Berner
$15^{00} - 15^{30}$ COFFEE BREAK VISIT TO THE INDUSTRIAL EXHIBITION			
$15^{30} - 17^{00}$	B. Pichler K. Hofer A. Robisson L. Nasseri	$15^{30} - 15^{50}$ $15^{50} - 16^{10}$ $16^{10} - 16^{30}$ $16^{30} - 16^{50}$	B. Hofko
$16^{50} - 17^{00}$ CLOSING CEREMONY			
$- 18^{30}$	GENERAL ASSEMBLY		