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Seminar über Ultrafast Science and Technology

Referent: Prof. Thomas Graule, EMPA, Dübendorf

Titel: Ceramics and Nanocomposite Research at Empa's Laboratory for High Performance Ceramics

High Performance Ceramic Materials and Nanocomposite Materials offer great perspectives in different fields, like in energy technology, clean technologies and in machine and computer industry. The application of nanopowders opens herewith the opportunity to develop nanocomposites with improved performance, e.g. relevant in fuel cell research or in advanced coating technologies. Some recent projects and activities covering these topics are presented in the first part of the lecture. The efficient stabilisation of ceramic based nano powders is a prerequisite for the achievement of these highly reliable ceramic nanomaterials. Agglomeration as a main origin of flaws can be avoided using different concepts to increase the separation barrier by electrostatic or steric means. Recently we performed detailed studies applying anion and cation type copolymers for the surface modification and stabilisation of alumina and zirconia submicron and nanoparticles. The studies were performed in order to develop a basic understanding of the mechanism of steric stabilisation in aqueous media [1-4]. We present here additionally new concepts to apply cationic comb copolymers as a promising alternative in case of the stabilisation of titania and silica. The effectiveness of the anionic and cationic dispersants is evaluated on the basis of adsorption, zeta potential measurements, rheology and particle size measurements [5-6].
References 1. Y. De Hazan, J. Heinecke, A. Weber, T. Graule, High Solids Loading Ceramic colloidal Dispersions in UV Curable Media via Comb polyelectrolyte Surfactants, J. Colloid Interf. Sci. 337 (2009) 66–74. 2. M. Wozniak, Y. de Hazan, T. Graule, D. Kata, Rheology of UV curable colloidal silica dispersions for rapid prototyping applications, J. Eur. Cer. Soc. 2011, 31, 2221-2229. 3. Y. de Hazan, V. Märkl, J. Heinecke, C. Aneziris, T. Graule, Functional ceramic and nanocomposite fibers, cellular articles and microspheres via radiation curable colloidal dispersions, J. Eur. Cer. Soc. 2011, 31, 2601-2600. 4. V. Klimkevicius, T. Graule, R. Makuska, Effect of structure of cationic comb copolymers on their adsorption and stabilization of titania nanoparticles, Langmuir 2015, 31, 2074-2083. 5. Y. de Hazan, Wilkens-Heinecke J.; Graule T., Modeling the effect of molecular architecture of comb polymers on the behavior of Al2O3 dispersions using charge/composition factors (CCF), Colloid Polymer. Sci. 2014, 292, 7, 1701-1710. 6. Klimkevicius V., Makuska R., Graule T., Rheology of titania based ceramic nanodispersions stabilized by cationic comb copolymers, Applied Rheology, accepted February 2016

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