LIGHT-INDUCED GRAFTING OF FUNCTIONAL POLYMERS TO NANODIAMONDS

Kilian N. R. Wuest,[abe] Vanessa Trouillet,[c] Ralf Köppe,[d] Peter W. Roesky,[d] Anja S. Goldmann,[abf] Martina H. Stenzel,[e] and Christopher Barner-Kowollik[abf]

[a]Preparative Macromolecular Chemistry, Institut für Technische Chemie und Polymerchemie (ITCP), Karlsruhe Institute of Technology (KIT), Engesserstr. 18, 76131 Karlsruhe, Germany

[b]Institut für Biologische Grenzflächen (IBG), Karlsruhe Institute of Technology (KIT), Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany

[c]Institute for Applied Materials (IAM-ESS) and Karlsruhe Nano Micro Facility (KNMF), Karlsruhe Institute of Technology (KIT), Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany

[d]Institute of Inorganic Chemistry, Karlsruhe Institute of Technology (KIT), Engesserstr. 15, 76131 Karlsruhe, Germany

[e]Centre for Advanced Macromolecular Design (CAMD), The University of New South Wales, Sydney NSW 2052, Australia

[f]School of Chemistry, Physics and Mechanical Engineering, Queensland University of Technology (QUT), 2 George Street, Brisbane, QLD 4000, Australia

ABSTRACT

Nanodiamonds (NDs) possess extraordinary properties, such as non-bleaching fluorescence, non-toxicity, addressable surface groups and ready availability that led to their investigation for various applications such as catalysis, sensing, drug delivery and imaging. However, for many applications the ND surface needs to be modified. For instance, a polymer coating can enhance their colloidal stability and introduce therapeutic drugs and targeting moieties.

Herein, we report two mild, light-triggered grafting protocols to modify NDs with polymers in the absence of any catalyst and at ambient temperature. Both approaches are based on the so-called photo-enol chemistry, where *o*-methyl benzaldehyde groups irradiated at λ = 320 nm form *o*-quinodimethanes (photo-enols) and subsequently undergo Diels–Alder reactions with activated double bonds. In the first approach, maleimide terminal polymers were grafted to photo-enol functional NDs.[1] The second approach includes the surface graphitization of nanodiamonds and the subsequent grafting of photo-enol functional polymers.[2] A variety of functional polymers were photo-grafted to nanodiamonds and the resulting polymer coated NDs were characterized by FT-IR, X-ray photoelectron spectroscopy, thermogravimetric analysis and dynamic light scattering. The effect of polymer chain length on grafting efficiency was investigated. Moreover, the co-grafting of two photo-enol terminal polymers to graphitized NDs is presented.

References:

[1]Wuest, K. N. R.; Trouillet, V.; Goldmann, A. S.; Stenzel, M. H.; Barner-Kowollik, C. *Macromolecules* **2016**, *49* (5), 1712–1721.
[2]Wuest, K. N. R.; Trouillet, V.; Köppe, R.; Roesky, P. W.; Goldmann, A. S.; Stenzel, M. H.; Barner-Kowollik, **2016**, submitted.