Controlled polymer functionalization, charge regulation, and ion transport in confinement of mesopores

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Nanopores are a key component in various technologies from oil production, separation and sensing, to drug delivery or catalysis and energy conversion. In contrast to technological pores, biological pores and channels demonstrate highly precise transport being directed, highly selective, fast, and gated. A key factor to this performance is their nanoscale structure and local control on charge regulation and polarity. Inspired by this performance and nanoscale precision we are interested in designing precisely functionalized nanoscale porous materials to understand and advance transport performance of technological pores, e.g. by pushing the limits of polymer functionalization in nanopores.[1,2]

This talk will highlight our recent advances related to improving polymer functionalization control in mesoporous thin films. This includes gradual variation of polymer amount and grafting-from of block co-oligomers in silica mesopores mainly focusing on iniferter-initiated RAFT polymerizations. In addition to grafting from functionalization, in-situ functionalization strategies based on specifically designed block-copolymers as functional template will be presented. Selected examples demonstrating the resulting ionic mesopore accessibility, determined by polymer chain architecture, polymer amount, monomer charge, and spatial confinement will be given. Thereby, especially charge-regulation in spatial confinement of mesopores and its influence on ionic transport will be discussed.

1. R. Pardehkhorram, A. Andrieu-Brunsen, Chem. Commun., Pushing the limits of nanopore transport performance by polymer functionalization, 2022, DOI: 10.1039/D2CC01164F
2. R. Brilmayer, C. Förster, L. Zhao, A. Andrieu-Brunsen, Recent trends in nanopore polymer functionalization, Current Opinion in Biotech, 2020, 63, 200-209.