MS16-O5

Lattice gas models and thermodynamics of gas uptake by porous materials from diffraction experiments

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Adsorption by a flexible small pore structure is frequently accompanied by a cooperative behavior; structural breathing [1] and hysteresis without phase transitions [2] may serve as examples of such a response. Collective phenomena associated with guest uptake by porous structures are of a practical interest for control of adsorption and selectivity as well as for fundamental research of cooperative effects in complex systems. We recently applied an Ising-like lattice gas model to rationalize a cooperative adsorption in porous materials. [3] A multi-site extension of the model with cooperative inter-pore and intra-pore guest-guest interactions specific for MOFs and alike materials is discussed here. Theoretical scenarios are compared with experimental observations provided by in-situ powder diffraction of synchrotron radiation analysis of active crystallographic sites and their occupancies. Elastic deformations of the host structure conjugated with pore population/depopulation is proposed as a basis of indirect cooperative interactions between guest molecules.

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Cracking the structural and morphogenetic basis of tooth biomineralization in snail-crushing cichlid fishes

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The teeth of cichlid fishes provide a powerful model for how vertebrates optimize dental hard tissues for ecologically relevant tasks. [1] Cichlid fishes have undergone explosive speciation in a very short time span, evolving tuning morphological specializations. Dramatic variability in the shapes and inner structures of their teeth and jaws are central to their diversification. [2] The main task of this research work is to determine the structure-property relationships of dental hard tissues of Cichlid fishes (so called “soft” and “hard” diet species) through detailed investigation of the composition, hierarchical structure and their mechanical performance. The most exiting are those Cichlid species that have repeatedly evolved exceptionally robust teeth to crush snails. Thus, we elaborate and combine an exciting evolutionary model system with cutting-edge spectroscopy, microscopy and diffraction techniques to analyze structural, chemical and morphogenetic basis of biomineralization process of dental hard tissues. Our new understanding of tooth structure and morphogenesis in cichlids could also advance strategies for synthesizing biomimetic materials for biomedical application. [3-4]

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