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Method to simultaneously probe the bulk modulus and structure of soft compressible objects using SANS

An object's bulk modulus quantifies its resistance to an isotropic compression. For soft deformable colloids the bulk modulus must be known to predict their response to crowding. Here, we will present a new approach to obtain partially-deuterated, high molecular weight polyethylene glycol (dPEG), which is used to exert osmotic stress on soft objects [1,2]. In this study, microgels were used as a model system for soft compressible spheres and their bulk modulus is determined by means of small-angle neutron scattering with contrast matching. By partial deuteration the scattering length density of the dPEG was matched in pure heavy water. Consequently, no contribution of the osmotic stress polymer is measured during the scattering experiments, and the form factor of the microgels was directly measured. Furthermore, in addition to the total radius, the variation of the different parts of the microgels can be also measured as a function of the external osmotic stress. Therefore, using this method the different elasticity along a single particle, such as viruses, can be determined directly.

[1] J. E. Houston, L. Fruhner, A. de la Cotte, J. Rojo González, A. Petrunin, U. Gasser, R. Schweins, J. Allgaier, W. Richtering, A. Fernandez-Nieves and A. Scotti, *Science Advances*, 2022, **8**, eabn6129

[2] A. Scotti, U. Gasser, A. V. Petrunin, L. Fruhner, W. Richtering and J. E. Houston, *Soft Matter*, 2022, doi.org/10.1039/d2sm00680d

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