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## **S E M I N A R** **aus** **Halbleiterphysik und Nanotechnologie**

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### **“Confinement in mesoporous materials and its implications for energy storage”**

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Mesoporous solids (pore width 2-50 nm) offer a unique environment in which structure and properties of guest species are remarkably affected with respect to bulk. We address confinement effects in mesopores mainly using small-angle scattering (SAXS, SANS) in conjunction with contrast variation techniques. This method allows comprehensive assessment of both structure and morphology of host and guest systems in a direct fashion. In the present paper the confinement of sulfur in mesoporous carbon materials for Li-S battery applications will be described. Compared to the manifold contributions on novel materials and their performances, very little is known in literature about the structure and morphology of this complex nanocomposite system. The distribution and filling mechanism of sulfur in CMK-8 carbon host could be precisely addressed using SAXS, thanks to the almost complete match between the electron densities of carbon and sulfur phase. Using small-angle neutron scattering (SANS) we investigated which effect solvents of different polarity (D<sub>2</sub>O, d-toluene, d-THF) have on the confined sulfur phase, to simulate the electrolyte-sulfur interactions in the battery. We could show that sulfur in contact with organic solvents was completely removed from the pore space thus showing major issues for the cell operation. Finally, operando studies on lithium sulfur batteries will be presented. The structural modifications of sulfur species in the carbon host during charge-discharge cycles will be reviewed by means of radiography investigations in combination with electrochemical methods.