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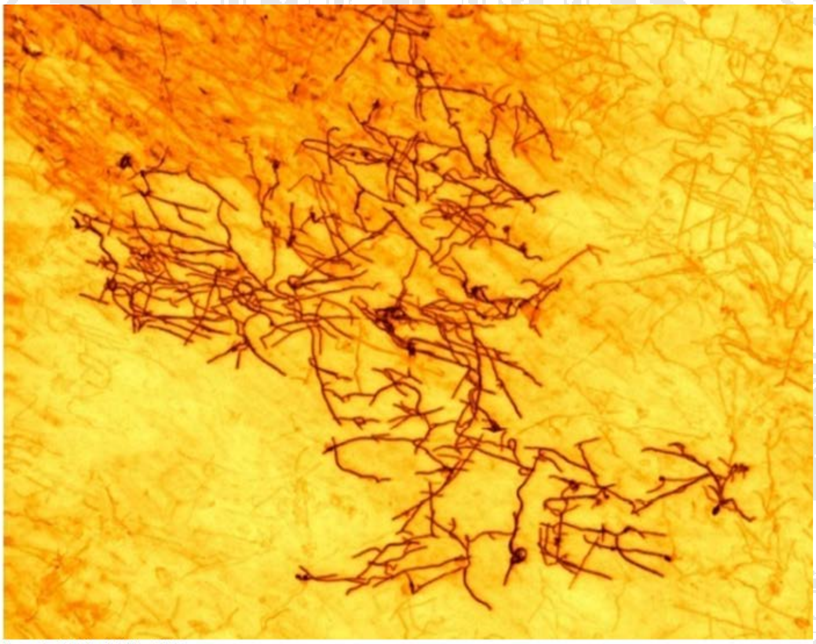
PHYSIKALISCHES KOLLOQUIUM

AM 13. NOVEMBER 2017 UM 17 UHR C.T.

IM GROßEN HÖRSAAL



Hermant, PhD thesis TU/e, 2009.

GEOMETRIC PERCOLATION OF HIGHLY ANISOMETRIC PARTICLES

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There is a considerable industrial interest in novel flexible, transparent electrodes for electro-optical applications, in part because of dwindling natural reserves of indium, a component of transparent electrodes used, e.g., in display technology. For this purpose, frantic research is currently being carried out worldwide into polymer composites containing electrically conducting inorganic and metallic nanowires, carbon nanotubes, grafite flakes, graphene and so on. One of the objectives is to get as high as possible a conduction for as low as possible a nanoparticle loading. Progress is slow, however. Unclear is why, e.g., carbon nanotubes dispersed in plastic matrix materials can have such widely diverging electrical percolation thresholds, even if their physical dimensions and other characteristics seem very similar. In an effort to shed light on issues like this, we apply continuous space connectedness percolation theory to collections of cylindrical particles that interact via a hard-core repulsion. We find that the percolation thresholds of rods and disks depend very differently on their aspect ratio, and that they are extremely sensitive to even quite modest degrees of polydispersity and alignment. The latter is induced in the processing of the fluid composites before they set and become the final solid product. Interestingly, introducing deformations in the shape of the cylindrical particles has a relatively weak influence on the percolation threshold, showing that idealised models are indeed useful.