Optical broadband characterisation of silica particles in chitosan thin films

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The optical properties of spherical silica particles are of great interest for the emerging field of passive radiative cooling technologies. For this cooling approach materials are required that show strong emission in the mid infrared wavelength region between 8 – 13 µm. Fortunately, the main absorption bands of silica are located in this spectral window. Various (composite) materials containing silica spheres as emitter were already theoretically evaluated and practically realized [1,2]. However, a fundamental understanding of the dependence of the optical properties on the interplay between size and concentration of the silica sphere relative to the polymer matrix is still lacking.

In the presented work we investigate the optical properties of silica particles dispersed in a chitosan matrix. Due to its poly-cationic nature, water based processability and good mechanical properties, chitosan is a suitable matrix material to support silica particles in thin films. At the same time the matrix material itself can be interesting for the use of thermal management as demonstrated by the Saharan silver ants [3]. Therefore, the combination of chitosan and silica has the potential to design novel materials with exceptional optical properties.

With our approach of freestanding thin films of embedded particles, a direct optical broadband characterization is possible. Thin films were prepared by doctor blading of particle/polymer dispersions. We conducted a systematic study of the effect of particle size and concentration on the optical properties of these films with UV-Vis and IR-Spectroscopy. Furthermore, the films were characterized with scanning electron microscopy to reveal the particle distribution within the film. With this we evaluated the potential of such silica/chitosan composite films for passive cooling technology.

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Acknowledgement: The authors acknowledge funding from the European Research Council, ERC StG VISIRday #714968.