# Rheological Characterisation of Hydroxypropylated Modified Nanocrystalline Cellulose Suspensions

Anders Johnson[1], Carina Olsson[2], Gunnar Westman[2], Anna Ström[1], Anette Larsson[1]

[1] Pharmaceutical Technology, Chemical and Biological Engineering, Chalmers University of Technology, 412 96 Göteborg, Sweden
[2]Organic Chemistry, Chemical and Biological Engineering, Chalmers University of Technology, 412 96 Göteborg, Sweden

## ABSTRACT

Cellulose is one of the most abundant biopolymers on Earth; it is biodegradable and renewable, making it a desirable raw material for various applications. It is composed of β(1→4) linked D-glucose units, which results in a stiff and rod-like polymer. Native cellulose fibers have both crystalline and non-crystalline parts. By hydrolysis in sulphuric acid amorphous parts are removed and the remaining nano sized cellulose crystals (NCC) are partly sulphonated. This leads to electrostatic stabilisation of NCC in aqueous suspensions. The NCC crystals are needle shaped with diameters between 5-70 nm and lengths from 100 nm to µm depending on the cellulose source and hydrolysis conditions.

Cellulose has certain inherent features, e.g. water insolubility. However, by introducing hydroxypropyl (HP) groups on the cellulose it is possible to obtain a completely water soluble polymer. The HP group disrupts the chain aggregation and facilitates water – cellulose interaction. Hydroxypropyl cellulose is used e.g. as food additives and in pharmaceuticals. Combining the properties of nanocrystalline cellulose and hydroxypropylated cellulose can be one way to produce a material with interesting water interaction behaviour. By careful substitution of HP groups on the surface of NCC it is possible to obtain modified NCC with increased water affinity without disrupting the core crystalline structure of the particle.

In this study, the properties of surface hydroxypropylated nanocrystalline cellulose (HP-NCC) were studied and compared with those of unmodified NCC. The size and shape of the material was analysed by means of light scattering and microscopy. The behaviour of HP-NCC and unmodified NCC in aqueous suspensions was studied by rheology. Deviations in the rheology indicate differences in the interactions between water and the functionalised crystal surface, and at higher concentrations interactions between the surfaces of the cellulose crystals. This might open up for new possibilities in preparing materials where control of the water - cellulose interactions are of importance.