

## Editorial corner – a personal view

### Nanocellulose – a renewable polymer of bright future

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Cellulose is the most abundant polymer in the world – by nature and by using renewable feedstock! One third of all plant material is cellulose and it is estimated to be the most common organic substance. Only a fraction of cellulose is utilized, mainly for lumber and papermaking. How could we utilize this renewable polymer in a better way?

One highly interesting option is to produce nanoscale cellulose fibers in different forms: fractal branched nanofibers, crystalline rod-shaped nanowhiskers or bacterially produced nanocellulose. Such nanofibrillated cellulose is expectedly ultra-strong and has in addition several other interesting properties like super-hydrophilicity and interesting rheological properties. [Chem. Soc. Rev., DOI: [10.1039/c0cs00108b](https://doi.org/10.1039/c0cs00108b)] Nanofibrillated cellulose (NFC) is in its basic form a dilute aqueous dispersion. This dispersion has interesting and applicable rheological properties, for example the flock formation properties are unique [J. Polym. Environ., DOI: [10.1007/s10924-010-0248-2](https://doi.org/10.1007/s10924-010-0248-2), Cellulose, DOI: [10.1007/s10570-011-9597-9](https://doi.org/10.1007/s10570-011-9597-9)]. To use nanocellulose in concentrated forms, in composites or as films, it usually needs to be chemically modified. Thus the chemistries that enable reactions in aqueous systems are highly interesting in this connection. One can mention Ce-catalysed free radical reactions based on the glucose ring opening, leading to the possibility of free radical graft co-polymerization. This chemical approach has enabled synthesis of thermoplastic, film forming and hydrophobic nanocellulose grades [Carbohydrate Polymers, DOI: [10.1016/J.CARBPOL.2010.12.064](https://doi.org/10.1016/J.CARBPOL.2010.12.064)].

Another interesting aqueous reaction family is the click chemistry in aqueous phase through which several functionalities can be attached to the nano-

cellulose. For example, amine functional nanocellulose grades have been synthesized that in a second stage have formed a covalent bond with functionalized graphene [J. Mater. Chem., DOI: [10.1039/C1JM12134K](https://doi.org/10.1039/C1JM12134K), Cellulose, DOI: [10.1007/s10570-011-9573-4](https://doi.org/10.1007/s10570-011-9573-4)]. Thus conductive cellulose nano composites have been produced utilizing the high surface area and fractal structure of the nanocellulose. Third feasible approach has been to chemically modify nanocellulose at the interphase of a two phase liquid system, where anhydride monomers are dissolved into an organic solvent and react at the interphase with the aqueous dispersion of nanocellulose. As a result, hydrophobic nanocellulose grades even super hydrophobic ones have been successfully produced.

Very interesting property of nanocellulose is its barrier properties as films or coatings. Extremely low permeabilities of oxygen have been reported, especially in dry conditions.

Nanocellulose is an excellent example of renewable natural material that enable a fine platform for polymer scientists to develop novel functional materials. Such not only are eco-friendly, but also show novel functional properties, which exceed those of today's synthetic polymers.



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