Editorial corner – a personal view

Nanocelluloses and their use in composite materials

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Cellulose nanofibres and crystals have gained a large interest, not only in the academic research society but also in industries, during the last few years. The number of published papers on this topic has increased from some few publications per year in 2005 to more than 500 in 2011. The research topics have been extraction methods of nanocelluloses, their properties, chemical modifications, self-assembling and their use in composites. It is obvious that the world's largest forest companies believe that nanocelluloses will lead to new uses of forest resources and open a new business area. The uses are expected to be new lightweight composite materials to be used in transport, electronic applications but nanocelluloses can also be used in food, cosmetics, medical, packaging and many other applications. The extracted nanofibres are usually around 20–30 nm in diameter and the length is estimated to be in μm range while the nanocrystals are much smaller, being about 3–5 nm in diameter and 200 nm in length. The properties of the cellulosic nanomaterials from natural resources (wood, bioresidues, annual plants) have shown to be very similar independent of the original source, meaning that the size distribution of nanofibres is an important factor and that it can be tailored for different applications. The main challenge, when producing cellulose-based nanocomposites, is to disperse the nanoreinforcements in the polymer matrix without degradation of the polymer or the reinforcing phase. Therefore the most common way to prepare cellulose nanocomposites has been the impregnation of 'cellulose nanopaper' by a polymer resin or use of solvents to disperse the nanocelluloses in a solved polymer. These methods show that composites with high mechani-

cal properties can be prepared but are restricted to thin sheets or films and also small scale process. To produce the nanocomposites in larger scale and with possibility to make different shapes, melt processing technologies need to be developed and that is a challenge because nanofibres and crystals are strongly hydrophilic and when dried it is very difficult to re-disperse them. We know that different chemical modifications, to make them re-dispersible, are usually affecting their thermal stability and crystallinity negatively and thereby decreasing the composites properties.

Now after some years intensive research, we can see several initiatives, which are taken to produce nanocellulose in large scale, and we are also waiting for the first commercial applications based on these materials. My opinion is that the first applications will not be composites but barrier coatings on board or paper for packaging applications, stronger paper, and transparent films for electronic applications, medical scaffolds and also nanoporous selective membranes. To be able to develop composites based on nanocellulose we have to solve the dispersion problem as well as to develop suitable processing technologies for large scale.

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