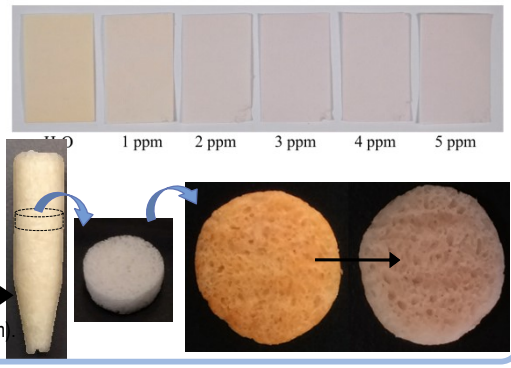
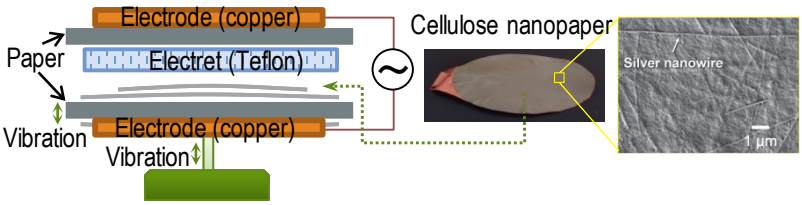
Paper device and Ecofriendly Material Sciences

Cellulosic materials for removing excess Cu^{2+} from drinking, agricultural, and industrial waters are under development. Paper-based sensors dyed with quinizarin change in color reacting with 2ppm of Cu^{2+}, a maximum allowed for drinking. Paper emphasizes the color change. Furthermore, cellulose sponge reinforced with cellulose nanofibers was developed to recover Cu ions for water purification and material recycling.



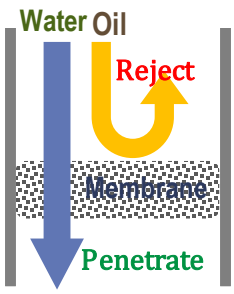
Quinizarin-printed filter paper becomes purple when immersed in copper nitrates (top).
Discs of nanofiber-reinforced sponge and copper ions recovery (bottom)

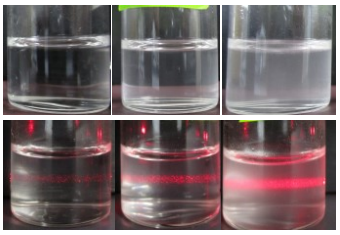


Power generator that makes an electrode approach and leave an electret (left). Composite nanopaper with a high dielectric constant prepared from nanocellulose and silver nanowire enhances the voltage when inserted (right).

Power generator converting paper vibration to electricity is under development. Paper vibration caused by sound or noise changes the distance between an electrode and electret (with static electricity) to generate power as a stand-alone power supply to apply in agricultural fields and forests and for navigation for visually impaired people.

Cellulosic membrane to efficiently separate oil/water mixture caused by food waste and marine accidents is under development . Common membranes allow water to pass through and reject oil, but washing oil is difficult. Therefore, membranes accepting oil and rejecting water were created. Cellulose sponge with cellulose nanofibers prepared from bamboo (BCNF) adsorbing on inner pore walls. This type had a higher separation efficiency than those from wood pulp (WCNF) and polyvinyl alcohol (PVA).

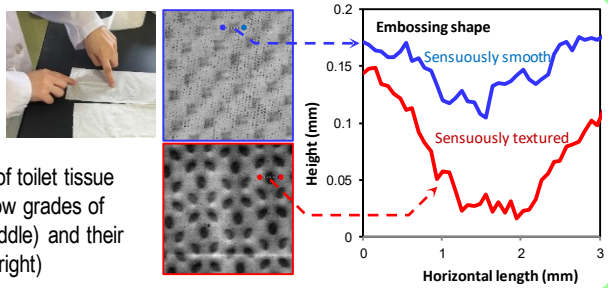




Concept of separation with a membrane (left) and comparison in separation efficiency among polymers adsorbing on inner pore walls in cellulose sponge. White turbidity (top) and Tyndall effect with red laser (bottom) represent oil droplets in water that penetrated.

Evaluation of comfortable feeling of toilet paper is conducted by sensory test. What paper properties determines sanitary product comfort? Shallower embossed patterns (raised mark on paper) gave greater comfort than physical smoothness and low friction.

Sensory smoothness of eight types of toilet tissue papers were tested by 30 subjects and ranked (left) and surface (height) profiles of toilet tissue papers with a high and low grades of sensory smoothness (middle) and their cross-sectional shapes (right)



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