Research team uses nanoparticles to make paper waterproof and magnetic

April 20 2012, by Bob Yirka

(Phys.org) -- Researchers at the Istituto Italiano di Tecnologia in Genoa, led by Roberto Cingolani, have devised a means for connecting cellulose fibers in ordinary paper with nanoparticles resulting in new desired properties, such as paper that is waterproof and magnetic, florescent or averse to bacteria. The team has published a paper describing their process in the *Journal of Materials Chemistry*.

The process involves mixing superparamagnetic manganese ferrite colloidal nanoparticles with individual molecules or monomers that make up the cellulose fibers in paper products or other nonwoven materials and getting them to connect, forming polymers, by submersion in a liquid solution. This process causes a thin shell to form around each fiber. The result is a solution that when applied to paper produces a final product that is both waterproof and magnetic. The team says they've also found that the amount of nanoparticles used in the process can be varied to adjust the degree of magnetism the paper will have.

By adjusting the kinds of nanoparticles used in creating their solution, the team has found that the resultant paper can be made to demonstrate other properties as well. Using silver nanoparticles for example, allows for creating paper that is resistant to bacteria. Similarly, florescent paper can be made using other substances. There also exists the possibility of mixing up the ingredients to create paper that demonstrates several of the properties, or conceivably all of them at once.

While the advantages of waterproof paper are obvious, the team notes

that making paper magnetic could be useful for security applications such as when making bank notes or even currency. Also, paper that has antibacterial properties could be used in medical applications or food preparations, or perhaps with currency as well seeing as how many studies have shown that paper money carries all manner of bugs that can make people sick. Florescent paper could be used in security applications but also would likely have a lot of other uses such as in making posters that don't require a black-light to create eerie effects, documents that could be read in the dark, or as a means of encoding data that only appears when the lights are turned out.

The team points out that because the paper as a whole is not being coated, the paper produced from the process retains all of its normal properties. Thus, it can still be written or printed on with normal pens and printers. Also, they say, the solution they create can be applied to paper that already exists, allowing users to change the properties of already printed books, magazines, documents or virtually any other paper product.

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