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Preparation of new smart materials based on cellulose paper

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Cellulose is the most abundant organic compound on earth, mainly produced by plants. This polymer plays an important role in many sectors such as nutrition, wood and paper, fiber and clothing, cosmetics and pharmaceutical industries. There is practically no previous work on the covalent modification of cellulose. In 2015, the group of Professor Felpin, from the University of Nantes, was the pioneer in this unexplored field, with the design of highlights applications from the covalent modification of modified cellulose papers. First, it has been developed cellulose-based sensors for the detection of different pollutants in wastewaters, such as heavy metals and hydrogen sulfate anion. These papers allow the colorimetric and high selective low-detection of these pollutants, with 90-95% removal efficiency. This practical technology should find broad applications in environmental and analytical sciences. Second, one biomimetic device for the detection of Cu(II) formed by covalently grafting of thioglycolic acid on cellulose paper has been developed. An unprecedented concept exploiting the properties of the above cellulose paper to promote catalyzed by the copper of the [3+2] cyclo-addition of organic azides with alkynes, absorbing the residual copper species in the solution was discovered. The potential of this innovative concept has been applied to the synthesis of complex scaffolds, including a new highly selective sensor for Cr (II) cations. Third, one new light-sensitive cellulose material for the storage of hidden optical data to be read with a UV lamp was developed. Our strategy, based on the reversible light-mediated dimerization of coumarin units covalently grafted onto the paper surface, allowed us to write complex patterns such as a QR Code. Finally, one contribution unveils and defines the concept of covalent printing onto cellulose paper through the support of a simple and efficient strategy. A photo-responsive cellulose paper bearing disulfide functional groups was created as a molecular print-board for spatio-temporal writing through thiol-X ligation of functional inks upon light irradiation. This strategy using molecular inks in a modular way culminated with the creation of patterns with a high resolution. Hidden covalent writing to the naked eyes was developed through the use of coumarin-based inks while the use of colored inks containing a rhodamine backbone established an uncovered pH-responsive covalent printing, both strategies can potentially find applications in the formation of anti-counterfeiting devices.

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