Color-changing and color-tunable photonic bandgap fiber textiles.

Prof. Maksim Skorobogatiy, Ecole Polytechnique de Montréal

1. M. Skorobogatiy, B. Gauvreau, N. Guo from the Department of Engineering Physics, Ecole Polytechnique de Montréal, Montréal, QC, Canada
2. K. Stoeffler, A. Ajji, C. Dubois from the Department of Chemical Engineering, Ecole Polytechnique de Montréal, Montréal, QC, Canada
3. J. Berzowska from Concordia University, Montréal, QC, Canada
4. K. Schicker, R. Wingfield from Textiles Futures Research Group, Central Saint Martins College, University of the Arts, London

We present the fabrication and use of plastic Photonic Band Gap Bragg fibers in photonic textiles for applications in wearables and smart clothing, signage, flexible display and built environment installations. In their cross section Bragg fibers feature periodic sequence of layers of two distinct plastics. Under ambient illumination the fibers appear colored due to optical interference in their microstructure. Importantly, no dyes or colorants are used in fabrication of such fibers, thus making the fibers resistant to color fading. Additionally, Bragg fibers guide light in the low refractive index core by photonic bandgap effect, while uniformly emitting a portion of guided color without the need of mechanical perturbations such as surface corrugation or microbending, thus making such fibers mechanically superior to the standard light emitting fibers. Intensity of side emission is controlled by varying the number of layers in a Bragg reflector. Under white light illumination, emitted color is very stable over time as it is defined by the fiber geometry rather than by spectral content of the light source. Moreover, Bragg fibers can be designed to reflect one color when side illuminated, and to emit another color while transmitting the light. By controlling the relative intensities of the ambient and guided light the overall fiber color can be varied, thus enabling passive color changing textiles. Additionally, by stretching a PBG Bragg fiber, its guided and reflected colors change proportionally to the amount of stretching, thus enabling visually interactive and sensing textiles responsive to the mechanical influence. Finally, we argue that plastic Bragg fibers offer economical solution demanded by textile applications.