Converting paper into laser-induced graphene for physical and biochemical sensors

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Laser-induced graphene (LIG), a porous, conductive, and flexible graphene foam produced by direct conversion of a wide range of carbon-containing materials by laser irradiation, has been gaining notoriety due to its ease of fabrication and broad applicability in fields such as energy storage and generation, transduction, electrocatalysis, water treatment, de-icing, antifouling, and biomedicine. Particularly appealing is the synthesis of this material from paper, a biodegradable, flexible and low-cost substrate. Here, we describe the formation of this paper-LIG using affordable IR (10.6 µm) and UV (355 nm) lasers and present several applications of this material (Figure 1). In particular, we demonstrate precise patterning of conductive paths onto fire-retardant treated filter paper for strain and bending sensing,[1] discuss the synthesis process under UV irradiation for humidity and temperature sensors [2] and introduce the synthesis of LIG from xylan, a widely available and underutilized biopolymer by-product of biorefineries.[3] Lastly, we take full advantage of the unique mix of features of paper-LIG, such as large surface area, porosity, good electrochemical performance and affordability, to present disposable uric acid biosensors capable of quantification of this clinically relevant analyte in real human urine samples. Overall, we provide an overview of the unique characteristics and vast capabilities of paper-LIG, highlighting its applicability in the field of low-cost and environmentally friendly sensing.

References

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Figures

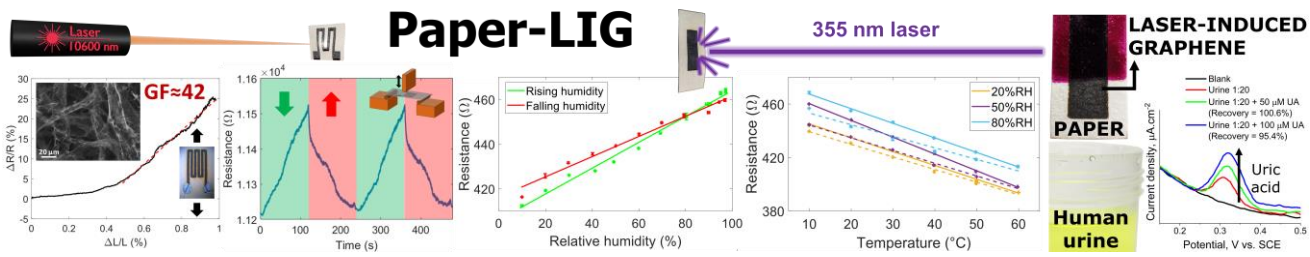

Figure 1: Different applications of paper-LIG.