Laser patterning of polymer composites with graphene, graphene oxide and aramid fibers, for the production of electric devices.

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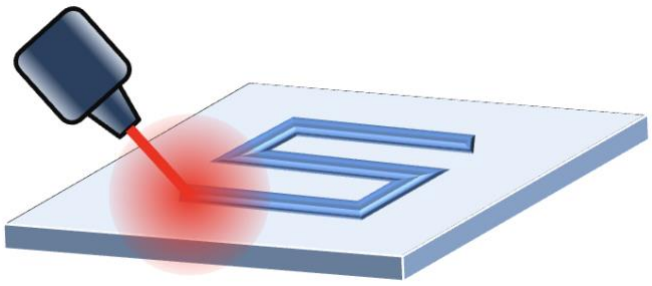
The diffusion of distributed electronics and IOT (Internet-Of-Things) requires cheap and rapid integration of electronic circuits in everyday objects, typically made of insulating plastic. This however implicates an increased complexity of the objects; the inclusion of metallic wires, sensors and buttons increases the production steps needed and final cost of the IOT objects; furthermore, addition of electronic metallic components to polymeric objects renders their recycling or end-of-life disposal more challenging and, again, more expensive. An original solution to add electronic capabilities to plastic object is to avoid the use of metallic conductors, creating instead electrical circuits on the surface of the object by local treatment, as example by a laser scribing technology (LS). In this approach, a conductive additive is added to the polymer at a concentration which is however below the percolation threshold; in this way, the bulk of the material remains electrically insulating. Then, a powerful laser is scanned on the surface of the object. The laser partially ablates the polymer, increasing the local concentration of the conductive additives which, eventually, touch each other forming an electrically conductive percolated network.
In this work we studied the mechanism of laser scribing in polyurethane composites containing different kind of graphene derivatives or precursors. In all materials tested, the laser patterning allows to draw conductive patterns with a resistance up to nine orders of magnitude lower than the pristine polymer, reaching very low ultimate sheet resistances (<10 Ω/square).
Finally, we demonstrated the versatility of this approach by producing different devices on the PU-based composites like a heater and an amperometric electrochemical sensor for the detection of biological analytes.

References

Laser patterning of polymer composites with graphene, graphene oxide and aramid fibers, for the production of electric devices. V. Parkula et al. Article in preparation.

Figures



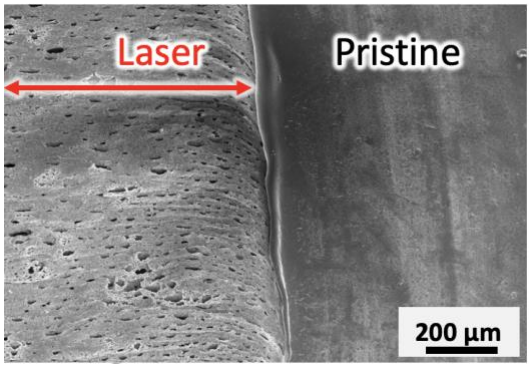


Figure 1: Schematic illustration of laser patterning. **Figure 2:** SEM image of a sample showing area irradiated with laser close to pristine, non-irradiated area.