Submission for e-print in Basle, Switzerland (1.12-2.12.2011)

Laser-induced forward transfer of thermoelectric materials on polymer and glass substrates

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Laser-induced forward transfer (LIFT) is a laser-assisted direct write method that has been used to print a range of solids and rheological fluids. The *donor* that is to be printed is previously deposited onto a transparent support substrate that is usually referred to as a *carrier*. A highly energetic short-pulsed laser beam imaged through the transparent carrier onto the donor results in the *forward* transfer of a donor pixel onto a *receiver* substrate placed either in contact or a few microns apart. Solid films can be transferred with minimal change in their crystal and domain structure via LIFT.

In order to establish the applicability of LIFT as a tool for the microfabrication of thermoelectric devices we have trialled the transfer of solid thermoelectric chalcogenides, in particular bismuth selenide and bismuth telluride, onto Parafilm (Pechiney Plastic Packaging Company), a solidified blend of paraffine and polyolefin, and glass receivers using nanosecond pulses from an KrF excimer laser source with a wavelength of 248 nm. The laser beam was imaged onto the donor/carrier interface to create a fluence in the range of 50 – 300 mJ/cm^2, whereas the former value corresponds to the fluence threshold for donor release. The donor films were previously prepared by sputtering onto a fused silica carrier.

We investigated the adhesion and the change of the printed donor pixels' structural and thermoelectric properties depending on laser fluence. The pixel morphology and material composition was studied by optical/scanning electron microscopy and by EDX analysis. Measurements of the Seebeck coefficients were carried out in order to compare the thermoelectric properties of the films before and after the LIFT process. The Seebeck coefficient for printed films was about up to ~ 80% of the value for donor films. In this contribution we describe the printing of intact as well as re-solidified thermoelectric donor material with pixel sizes of several mm^2, and the effect of LIFT on their thermoelectric properties. Finally, we will report our progress towards the fabrication of a thermoelectric generator used as a device for energy harvesting.

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