Low-power photo-carving of dye-volatile cocrystals: The sublime cutting edge of light-responsive materials

T. H. Borchers, F. Topić, T. Friščić, C. J. Barrett

McGill University, 801 Rue Sherbrooke Ouest, Montréal, QC H3A 0B8

tristan.borchers@mail.mcgill.ca

Laser beam machining (LBM) of ceramics, polymers, or metals is usually performed using high-power femtosecond lasers (4–20 W). Using LBM, micro- or nano-sized patterns can be machined into surfaces of these materials to alter their properties for various applications. A drawback of such high-power techniques is the possibility of considerable chemical damage to the surface of the machined materials.

We now report the use of halogen bonding to generate new dye-based cocrystals with volatile cocrystal-forming molecules (coformers) that can be etched, cut, and punctured with micrometer-scale precision using low-powered laser beams (for example, between 0.5 and 20 mW).[1] This unique phenomenon, shown to be wavelength-tunable and powerdependent, can be utilized to machine molecular crystals by forming holes or cuts of controllable sizes. Using a microscope-guided low-power laser beam numerical control of this process can be achieved, enabling a variety of complex patterns to be inscribed onto the surface of molecular cocrystals. A mechanism is proposed with the volatile conformer acting as a leaving group, giving the ability to gently inscribe patterns using a low-power laser beam, without chemical decomposition of the cocrystals. This has not been previously reported in small molecule organic solids and appears to be a new emergent property achievable through crystal engineering by halogen bonding, opening a new type of materials to micrometer-scale shaping and machining applications.

[1] Borchers, T. H., Topić, F., Christopherson, J. -C., Bushuyev, O. S., Vainauskas, J., Titi, H. M., Friščić, T. & Barrett, C. J. (2021). *ChemRxiv. https://doi.org/10.26434/chemrxiv.14398856.v1*

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