

Application of CO₂ laser for 3D printing utilizing thermal assisted polymerization of PVC plastic

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Abstract

In this article fabrication and testing of a 3D printer based on polymerization of PVC plastic under CO₂ laser exposure is discussed. PVC is the third most widely used plastic in the world. Its monomer called Vinyl Chloride (Chloroethen) is in liquid form. Once heated, the polymerization process starts and the liquid monomer solidifies to produce Poly Vinyl Chloride (PVC). In our setup for 3D printing application this heat is produced by selective exposure of Vinyl Chloride monomer by CO₂ laser. The structure of the 3D printer is the same as conventional SLA 3D printers except that instead of photopolymerization of a resin by a UV laser, CO₂ laser performs the Polymerization of PVC plastic. A tank is filled with Vinyl Chloride liquid monomer, a build plate is placed below the surface of the liquid and the CO₂ laser scans the first layer of a model on the surface of the liquid tank utilizing a galvoscaner. The exposed area polymerized, solidifies and attach to the build plate. The build plate is then lowered in the tank by 100 micrometer and a blade spreads fresh monomers on the first polymerized layer. The CO₂ laser scans the second layer. This process is repeated until the model is complete. Next, the built model is rinsed and baked in an oven to unify the layers and a hard solid PVC plastic model is produced. The fabrication process is presented and the effect of different parameters such as laser power, scanning speed and post bake process on the quality of models is discussed.