Final Report

Project acronym: *RIPE4TEC*

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Publishable project summary

Epoxies are important thermoset materials with a broad range of applications. They are nominally homogeneous, have high strength and stiffness, but are brittle. Within RIPE4TEC we have developed heterogeneous epoxies manufactured via additive reactive inkjet printing (RIP) with the goal of improving ductility, without compromising the strength and stiffness. To this end, we have developed a reactive inkjet printing technology in which the resin and hardener components are printed successively using multinozzle printheads, and which provides control of the local stoichiometric ratio. This allows creating epoxies with both in-plane and out-of-plane local compositional and mechanical heterogeneity. Additionally, we embedded silica nanoparticles in one of the reactive inks that upon curing result in inkjet printable epoxy nanocomposites. As a result of the project, the scope of additive manufacturing (AM) via RIP has been broadened to cover a novel and importand material class (thermosetting two-component epoxy). We have printed and tested our heterogeneous materials with several microstructural designs and demonstrated significant improvement of ductility, with retention of strength and stiffness. Furthermore, the strength and stiffness of printed nominally homogeneous samples are close to isotropic and identical to those of the cast material of the same composition. The technology developed makes use of commercially available inks (resin and hardener), it is fully automated and provides sufficient flexibility and productivity to print complex macroscopic samples with 50 µm resolution of microstructural composition control. Homogeneous and heterogeneous epoxies and their corresponding micro- and nanocomposites have thus been enabled for AM via digital RIP for the first time.