MATERIALS SCIENCE AND TECHNOLOGY

PNRR - 3D printing of sustainable polymer-ceramic photocurable resins

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Context of the research activity	Within the frame of the project MICS (MADE IN ITALY CIRCOLARE E SOSTENIBILE), the “Spoke 6 – Additive manufacturing as disruptive enabler of the twin transition” has the goal to create a new generation of products exploiting additive manufacturing of more sustainable materials. Vat-photopolymerization 3D printing technologies, such as stereolithography (SLA) and digital light processing (DLP), rely on layer-by-layer curing and solidification of photocurable resins by UV light. One of the main concerns related to this process is that most of the available materials are oil-based (typically multifunctional epoxy or (meth)acrylate monomers), not biodegradable and not suitable for biomedical-engineering purposes. Therefore, the focus will be on 3D printing of more sustainable photocurable resins with properties comparable to petroleum-derived resins and polymer-ceramic composites with improved properties (physical, mechanical, aesthetical and functional). Progetto finanziato nell'ambito del PNRR - PNRR M4C2, Investimento 1.3 - Avviso n. 341 del 15/03/2022 - PE0000004 3A-ITALY Made in Italy circolare e sostenibile - E13C22001900001
Objectives	To facilitate the ongoing transition toward a circular economy, bio-based and/or biodegradable UV-curable resins for DLP (Digital Light Processing) additive manufacturing will be investigated. Monomers/oligomers and photoinitiator ratio will be opportunely tuned to achieve optimal rheological properties and high quality 3D-printed parts. To further improve mechanical, physical and aesthetical properties, polymer-ceramic composites will be investigated as well. To this extent, the interactions between the ceramic filler and the polymer matrix will be opportunely investigated, depending on the ceramic solid loading and their different refractive indexes. Moreover, as further point of study, composite mechanical properties can effectively be increased through ceramic particles functionalization.

Skills and competencies for the development of the activity	The applicants: - should have a material engineering or chemical engineering background and high motivation to conduct experimental research; - should demonstrate autonomy in laboratory activities and problem-solving; - should have the ability to summarize literature and experimental results; - will learn about additive manufacturing technologies; ceramic particles synthesis, modification and characterization; polymer-ceramic composites preparation and characterization.