Project Snippet

Complete title of the project:
TEchnologies for sustainable **A**dditive **M**an**U**facturing and **P**ost-processing – TEAM UP

Principal Investigators:

Details	Indian PI	German PI
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Designation	Associate Professor	Professor
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Institutions involved:

- Indian Institute of Technology (IIT) Palakkad, Kerala, India
- TU Bergakademie Freiberg, Freiberg, Germany

Short Project Summary (few lines)**:**
Additive manufacturing (AM) technology is an evolving technology that enables complex part production with customized designs. The recent global surge in road accidents forces the biomedical sectors to rely on AM technology for curing the grievous/fatal injuries using patient specific implants. Similarly, diseases like osteoporosis demand the support of AM for customized implant fabrication. Despite the technology potential, AM metallic implants currently face limitations in surface quality and geometric precision, hindering direct implementation in patient's body. Existing post-processing methods are less efficient towards complex and customized AM parts. Plasma electrolytic polishing (PeP) is a promising eco-friendly alternative that can easily adapt to complex/customized AM designs irrespective of the part size. In light of this, an exhaustive research plan is proposed to establish the reliability and scope of combined AM-PeP approach in implant processing for ensuring extensive adoption in biomedical industries. The project phases involve metal 3D printing of CoCr alloys, PeP post-treatment and associated characterization of the components in printed and post-processed conditions. Further, the investigation aims to develop a novel design framework as well as an efficient AI model that can expedite quality-assured and economically feasible patient specific implant production in biomedical industries.

Expected Outcomes (Key goals, impact areas, or potential deliverables):

The project aims to support biomedical industries by enabling cost-effective production of implants with required functional performance that meet industrial standards. The main beneficiaries will be patients with severe injuries needing implant surgeries. While AM technology allows customization of implants for patient-specific needs, the limitations of poor surface integrity and low geometrical accuracy affect implant functionality. A refined polishing strategy and procedure resulting from the project is expected to overcome such limitations and can facilitate the successful implementation of AM implants in patient's body. The PeP implants can ensure the surface quality standards, stringent form tolerances and desired functional performance in terms of biocompatibility and mechanical properties. The project will deliver three journal publications, two conference presentations, two patent filings and a comprehensive monograph titled "Eco-friendly electrolytic post-processing of additive manufactured patient specific implants". Additionally, two academic workshops will be organized in phases to foster interdisciplinary collaboration between medical and engineering communities, emphasizing sustainable practices and eco-friendly measures throughout the research and dissemination process.