Development and implementation of a filament cooling module for processing Copperfill filament

The aim of the project is to design an extension to an existing FDM printing system to enable the process-stable processing of Copperfill filament. The copper particles contained in the filament place specific demands on the printing process, particularly with regard to the filament's thermal behaviour. During the printing process, the filament is heated in the hot end and then extruded. The copper particles contained in the Copperfill filament cause heat to be conducted further along the filament from the hot end towards the extruder. As a result, the filament can heat up even before it reaches the hot end, although it must remain sufficiently dimensionally stable to ensure reliable feeding and extrusion. Excessive heating and the associated plasticisation of the filament impair reliable material feed. The resulting fluctuations in feed rate can cause uneven extrusion and thus compromise the quality and process stability of the component manufacturing process.
Within the scope of this project, a filament cooling module is therefore to be developed and integrated into the existing FDM printing system. The cooling module is intended to cool the filament specifically outside the hot end, thereby limiting unwanted heat propagation. To this end, the thermal boundary conditions and the requirements for the cooling system must first be investigated and defined. Building on this, a suitable concept is to be developed, designed and manufactured. In addition to the mechanical design and implementation of the cooling module, the work also encompasses the development and implementation of the necessary electrical control system.
Following the implementation of the cooling module, printing tests are to be carried out to verify its function and to assess the impact of the additional cooling on process stability. In particular, the study will examine the extent to which the use of the cooling module enables the reliable processing of Copperfill filament.
To assess print quality, specimens are to be produced and examined both with and without the cooling module. Microscopic images will be used to identify differences in material structure and layer build-up, as well as any print-related defects. In addition, tensile specimens will be produced under defined process parameters and subjected to mechanical testing to determine the influence of the cooling module on the mechanical properties of the components. By combining the microscopic and mechanical investigations, the cooling module will be evaluated in terms of print quality and component properties.

Prerequisites:

- An interest in materials science and additive manufacturing
- (Basic) knowledge in the field of CAD and FDM printing systems

Type of position:

- **Practical study placement (15 ECTS) at the WWHK**
- **Practical placement and Bachelor's thesis (30 ECTS) at the WWHK**
- **Research and development module (10, 20 or 30 ECTS) at the WWHK**

Duration and extent depend on the study regulations and the nature of the student's work

Start date: immediately

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