# High-temperature 3D Printer for Magnetic Field-Assisted Additive Manufacturing (MFAAM) of Bonded Magnets

# **ABSTRACT**

Bonded magnetic composites (BMC) offer greater feasibility compared to sintered magnets due to their resistance to corrosion, ease of manufacturing and shaping, and suitability for additive manufacturing processes. The magnetic properties of these bonded composites can be tailored for specific magnetic orientations through magnetic field-assisted additive manufacturing (MFAAM). Polymers for example polyether ether ketone (PEEK), and polyamide stand out due to their high glass transition and melting temperature, enabling operation at elevated temperatures, and making them ideal for BMC. However, manufacturing such high-performance BMC using these polymers on a 3D printer requires printing at higher temperatures, which presents challenges such as uneven bed adhesion, layer delamination, and the potential for damaging printer components. To overcome this problem, this study focuses on modifying an off-the-shelf desktop 3D printer by incorporating a liquid nozzle cooling system and an external bed heating lamp unit to develop anisotropic polyamide 4.6 bonded magnets using a novel high-temperature MFAAM technique. This technique employs a Neodymium Halbach Array Magnet for applying a magnetic field while 3d printing magnets. In this research composite filaments will be produced using the twin screw extrusion technique, employing PEEK as the binder matrix, with Strontium ferrite powder serving as a filler. We will evaluate the magnetic properties using a vibrating sample magnetometer and assess the mechanical attributes, like tensile and bending properties, of the produced magnetic composites. The morphology of printed magnets will be analyzed using Scanning electron microscopy. Thermal transitions and thermal stability will be analyzed through complex thermal tests like differential scanning calorimetry (DSC) and thermogravimetry (TGA).