Proposal Code : PDF-FusionTech-0005	
Title	Development of Inorganic adhesive for Fusion grade Cryopump application
Abstract	Fusion tokamaks require a highly reliable pumping system to pump helium ash along with unburnt fuel, which comprises hydrogen isotopes, namely deuterium and tritium. For this purpose, Cryopumps are one of the identified reliable candidates as they offer high pumping speed. Towards the indigenous development of cryopumps, liquid helium cooled pumps were developed with a high pumping speed of ~70000 litres/sec for hydrogen. After this, the improvement of cryopumps is required for their application in fusion reactors and neutron environments. One of the delicate components of the cryopump is cryopanels, which are made up of Stainless Steel and coated with activated charcoal with the help of a suitable adhesive. The charcoal and SS are quite stable elements and highly immune to radiation. But the adhesive, which is polymeric in nature, may lose its adhesion properties because of the radiation damage to its basic structure. Because the fusion neutron environment and tritium eventually degrade organic bonds, research to achieve a thermally conducting bond using an inorganic bonding agent is required. Various experimental studies have shown that available epoxy-based adhesives are not suitable for such applications. The other category, which is identified as adhesives, is silicon-based adhesives, which show greater immunity towards radiation damage to their structure. Scope of the work are listed as follows: • To develop an inorganic low-temperature (4 K) adhesive. • Sticking performance of the adhesive for adhering charcoal to Stainless steel. • To characterize the adhesive for its chemical, physical, mechanical, and thermal properties for the desired application in fusion-grade cryopump. • To develop a methodology for the synthesis of the glue in large quantities.

Research Focus Areas	The proposed research would generate know-how information on the synthesis of inorganic adhesives. The development of such an adhesive will be a milestone achievement towards the development of fusion-compatible pumping systems.
Qualifications	PhD in Physics
Desired Experience	Expertise in synthesis and charcaterization of different materials. Knowledge of fusion and its interaction with different materials is desirable. Preference will be given to candidates with prior experience in characterizing and testing of organic and inorganic compounds.
Other remarks	As the thermal expansion co-efficient of stainless steel and adhesive will be different hence at very low temperature and high temperature as well annealing temperatures it is expected that the cracks will generate due to rupture of adhesive layer on the surface of steel. Hence, bonding of adhesives needs to be studied and different fillers can be added to make flexibility in polymeric chain. Also, process of inorganic adhesive synthesis needs to be established.