Cryogenic insulation in high voltage engineering

Dielectric long term strength and ageing of polymer mixed dielectrics for applications at cryogenic temperatures

The continuing research and development of high-temperature superconductors increases their potential for the energy sector. The advantages in comparison to conventional copper and aluminum conductors are a higher efficiency of electrical machines and lower losses in energy transmission.

Commonly used dielectric insulations of superconducting systems are based on liquid nitrogen. Liquid nitrogen has a high volume and area effect, especially in case of thermal gas bubbling, which decreases the dielectric strength. Conventional solid insulation systems show a high shrinkage of the volume, which increases the danger of occurrence of stress cracks. As an alternative material, a possible solution is syntactic foam. It has been investigated at the Institute for High Voltage Technology at RWTH-Aachen for longer than a decade. Syntactic foams show good characteristics at cryogenic temperature, e.g. low shrinkage of the volume and a high dielectric strength.

Figure 1: Laboratory for cryogenic high voltage investigations at IFHT

Until now, there has not been any research on the long-term ageing and its mechanisms at cryogenic temperature. Therefore, in this DFG-project, the life expectancy of syntactic foam will be investigated and influencing factors for premature ageing will be identified. The project focuses on the conditions of defect creation as well as the progress of the electrical breakdown. Long-term investigations are conducted under ac and dc stress at cryogenic

temperatures using different material compositions. For possible DC applications, accumulations of space charges in syntactic foam will be analyzed, focusing on critical field distortions. The investigation will be done using different electric field strengths and temperatures to quantify the space charge's intensity, followed by simulative studies on their distribution. The influence of space charges on the local electric field strength shall be determined to identify possible local overloads that can be matched to the results of the long-term investigations.

Project Information

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Facts

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