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LONG TERM STORAGE ISSUES OF NDFEB MAGNETS: COATINGS AND PEEK/ NDFEB COMPOSITES AS ALTERNATIVE APPROACHES

Abstract

Permanent Rare Earth magnets are becoming more and more important in efficient motors and generator with high energy density. In space domain, they are usually the core of electrical motors used for mechanism, having a crucial importance in the success of the mission. Two compositions are mainly used for space applications: NdFeB and SmCo magnets. NdFeB magnets, are cheaper to manufacture and have superior magnetic properties at room temperature but they are, in general, susceptible to corrosion. SmCo magnets have very stable magnetic properties at high temperature and have better corrosion resistance but lower magnetic properties with respect to NdFeB magnets. NdFeB magnets have indeed higher remanence, much higher coercivity and energy product. The selection of magnet composition is one of the mechanisms design driver and NdFeB are often preferred in order to obtain high magnetic performance with lower volume. When using NdFeB magnets various problems could occur due to their poor corrosion resistance, such as degradation of magnetic properties and/or contamination due to corrosion particles. Unlikely, corrosion issues related to NdFeB magnets were reported not only during exercise, but were observed in long-term stored devices, despite the storage was under controlled temperature and humidity environment. This is surely a hot point as new demanding requirements of Long Term Storage for Telecommunication and Earth Observation satellites are addressed, where the study of the corrosion behaviour of NdFeB magnets and possible protection methods is pursued. As part of this activity, different approaches were followed in parallel to face the long-term storage issue. The first one, more traditional, concerns the use of corrosion-resistance polymeric coatings applied to sintered NdFeB magnets. The specimens were tested in an environmental chamber, simulating the long-term storage conditions and analyzed by means of optical and electronic microscopy to evaluate the possible corrosion. The second approach, instead, focuses on the manufacturing of polymer composites, where NdFeB powders are added to a polymeric matrix (PEEK) as functional filler. This has a double effect of protecting the magnetic alloy, preventing it from corrosion, and to realize a new material that can be shaped in the form of filaments, to be used as

feedstock in the 3D printing process. The composites were manufactured and test are ongoing for both filaments and 3D printed samples. The use of 3D printing technology, could also allow combining the development of new magnetic materials with a conceptual redesign and optimization of space mechanisms.