

Applications of rapidly solidified magnetic materials for structural health monitoring of engineering components

Amitava Mitra, R K Ray and A K Panda
CSIR-National Metallurgical Laboratory, India

One of the most popular ways of preparation of rapidly solidified soft magnetic materials is the melt-spinning of the molten alloys to form materials in the form of ribbon. The bulk use of these materials is the low loss transformer core materials. However, these materials have wide applications as sensing devices due to their superior properties due to the absence of magnetocrystalline anisotropy. One such application is the generation of ultrasonic guided wave using rapidly solidified Fe-Si-B based magnetostrictive ribbon for pipeline inspection. The system has been found suitable for detection of weld defect in pipeline. Even defects in underground pipeline were also demonstrated using magnetostrictive sensing device. In-water quenching of the melt is another way of preparing rapidly solidified materials in the form of wire. Nearly zero magnetostrictive materials in the form of wire exhibit Giant Magneto-Impedance

(GMI) properties. The FeCoCrSiB based materials shows GMI ratio as high as ~500% in properly annealed state. Using such materials a sensing device has been developed named as MagSys which was used for damage assessment in petrochemical industries. During cracking of hydrocarbons in catalytic converter for refining of petroleum, carbon deposited which diffuses in steel during extended period of service. The diffused carbon in the steel component changes its composition and mechanical properties of steel deteriorate resulting in catastrophic failure. Such compositional changes can go to such an extent that a non-ferromagnetic stainless steel becomes very weakly magnetic. MagSys was used to find the extent of carburization in the Catalytic Converter Reactor Unit of a refinery unit of an oil company of India.

Biography

Amitava Mitra joined CSIR-National Metallurgical Laboratory, Jamshedpur, India, in the year 1990 after completing his PhD from India Institute of Technology, Kharagpur and Post-doctoral research from Applied Magnetism Lab., Spain. He has about 140 publications in reputed journals and 12 patents in the area of Magnetism and Magnetic Materials. He is recipient of US-AID and also JSPS invitation fellowship.

amitra@nmlindia.org

 Notes: