

## Development and Applications of Magnetic Fe-based Bulk Glassy Alloys

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Since the first synthesis of Fe-based bulk glassy alloy in Fe-Al-Ga-P-C-B system in 1995 by our group, a variety of Fe-based bulk glassy alloys with ferromagnetism at room temperature have been developed up to date by a copper mold casting method. The alloy systems of their bulk glassy alloys can be divided into the following six groups; (1) Fe-(Al,Ga)-(P,C,B,Si), (2) Fe-(Cr,Mo)-(P,C,B,Si), (3) Fe-(Zr,Hf,Nb)-B, (4) Fe-Ln-B (Ln=lanthanide metal), (5) Fe-Nb-(P,C,B,Si) and (6) Fe-(P,C,B,Si). All these alloys exhibit glass transition, followed by a large supercooled liquid region with the largest temperature interval of about 100 K before crystallization. The critical diameter size lies in the range from 1.5 to 7 mm and the largest value is obtained for Fe-Nb-metalloid base system. Among their bulk glassy alloys, two group alloys of (2) and (5) have been used as soft magnetic consolidated core materials with commercial names of Licalloy and SENNTIX, respectively. The saturation magnetization and coercive force of these commercialized alloys are 1.10 to 1.35 T and 2 to 5 A/m, respectively. The powder/resin core materials produced by the powder metallurgy method exhibit high electrical resistivity of about 300 k $\Omega$ cm, nearly constant permeability in a wide frequency range up to several MHz, good DC-superposed characteristics in a current range up to 20 A and low core losses in a wide frequency range up to 200 kHz. It is noticed that the core losses are much smaller than those for Fe-Al-Si Sendust and Ni-Fe-Mo Permalloy cores and the DC-superposed characteristics is much better than that of Mn-Zn ferrite. These good soft magnetic properties result in practical uses as power inductor, noise suppression sheet, radio frequency identification sheet in various kinds of electric-magnetic devices such as personal computer, cell phone and digital still camera. The unique characteristics which cannot be obtained for previously reported soft magnetic cores are expected to extend further their application fields in the near future.