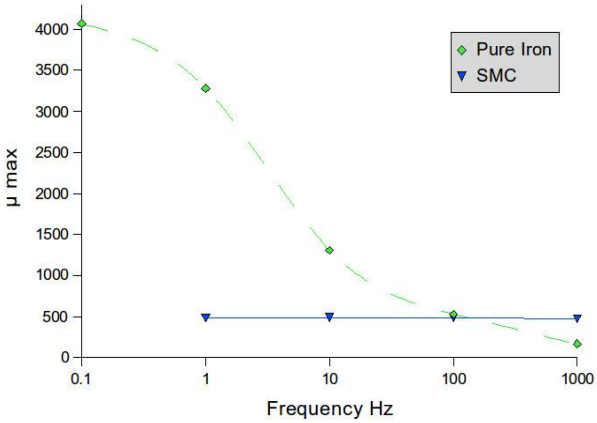

Figure 14: Variation of maximum permeability with frequency of magnetisation for sintered pure iron and an SMC material

In recent years the number of grades of SMC materials available has proliferated, with variations to the base powder grain size and the type and quantity of insulator allowing the properties of the material to be targeted to specific types of application. SMC grades are now available which permit curing at temperatures high enough to give effective stress relief, which allows maximum permeabilities of up to 1000 to be achieved. Raising the permeability much beyond this level is limited by the insulating layers within the material forming a distributed air gap. Improved pressing lubricants and the use of warm compaction allow high densities (>7.5gcm^{-3}) to be achieved in order to maximise induction. Other grades have insulating systems which allow them to operate at frequencies of tens or hundreds of kHz. Table 7 shows the ranges of properties available from currently available SMC materials.

SMCs are increasingly being chosen for the production of high efficiency motors, ignition cores [2], transformers, chokes, sensors, or fuel injector cores. Figure 15 shows components from two types of PM soft magnetic material which form part of a variable stiffness engine mount. The part on the left is an orifice plate fabricated from Fe-0.45%P while the part on the right is a core plate produced from an SMC material. By varying the magnetic field in the core plate, the viscosity of a magnetorheological fluid is altered, and hence its resistance to passing through the slots in the orifice plate. This system is used in the Porsche 911 GT3 to improve handling dynamics by holding the motor rigidly during hard cornering, while maintaining driver comfort during more relaxed driving.

Property	Typical values
μ_{MAX}	300 - 1000
B_{max} at 10kAm^{-1} (T)	1.32 – 1.63
TRS (MPa)	30 - 140
Losses at 1T, 400Hz (W/kg)	32 - 63
Resistivity (μΩ.m)	70 - 22200

Table 7: Ranges of properties obtainable in different SMC materials

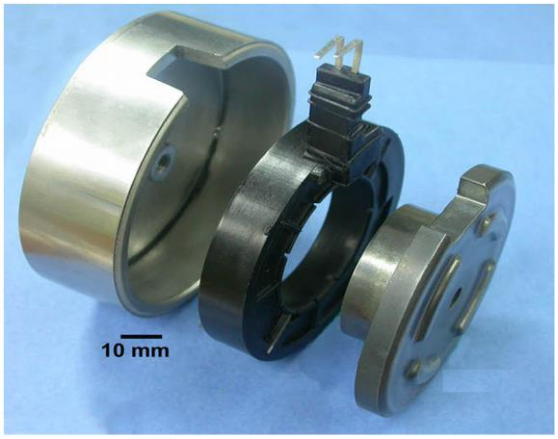

Figure 15: Orifice plate, winding, and core plate from a variable stiffness engine mount

IV. Conclusions

In the automotive sector the number of opportunities for electro-magnetic components in transmission, braking, steering and emission control systems is steadily increasing and, with the advantages of net-shape production and the great range of soft magnetic materials available in powder form, the PM sector is well-placed to take advantage of this.

V. Acknowledgements

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VI. References

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VII. Biography

Mark J. Dougan was born in Watford, England in 1968. He received his B.Sc. and Ph.D. in Metallurgy from the University of Manchester in 1991 and 1995 respectively. He worked as a Research Assistant in the Thermal Spray Centre in the University of Barcelona, and in the Department of Metallurgy in the University of Leeds before joining AMES, SA in Barcelona in 1999. He is currently Chief Metallurgist in the AMES PM Tech Centre, working on material and process development, failure analysis, and with special responsibility for soft magnetic materials.