NOTE ON THE POLISHING OF SMALL SPHERES
OF FERRIMAGNETIC MATERIALS

par

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This note describes a simple and rapid method that we have used for obtaining a high degree of polish on spheres of ferrimagnetic materials. A high surface polish is of particular importance if one desires to perform ferrimagnetic resonance experiments on very narrow linewidth materials such as Yttrium Iron Garnet. It is not possible to obtain the very narrow linewidths without polishing the sample with a very fine abrasive such as "Linde A" [1]. Although the methods presently used for the fine polishing of ferrite spheres [2][3] give satisfactory results, the method described here is of particular interest because of its simplicity and speed. For example with the air-jet tumbling technique it can take as long as three days of polishing to obtain an acceptable surface while our method will give the same results in one to two hours.

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The apparatus, shown in Fig. 1, consists of a cylinder of plexiglass, containing a cylindrical cavity, which is mounted upon the shaft of a motor. A 0.5 mm thick plastic paddle is placed in the cavity perpendicular to the walls. This paddle is held fixed by a shaft that extends through the cavity cover. In operation the cavity rotates, being attached to the shaft of the motor, while the paddle is held in a fixed position. The abrasive is introduced in the form of an alumina and water mixture (about 1 cm³). The purpose of the paddle is to keep the sphere in the best position to be polished by the alumina and, for this reason, the distance between the edge of the paddle and the cavity wall must be carefully adjusted. The distance must be such that only the alumina and water mixture may pass the paddle but not the sample. If the paddle touches the wall, the turbulence will be so great that the sample will not remain against the wall of the cavity and the polishing speed will be greatly reduced. If, on the other hand, the spacing between the wall and the paddle is too great, the sphere will not be held in place by the paddle but will slip by it and the polishing speed will again be greatly reduced.

When the apparatus is correctly adjusted, one can see the sample through the plexiglass wall moving slowly up and down while lodged against the paddle and the wall of the cavity. The plexiglass cylinder is not coupled directly to the motor but is coupled by means of a thrust bearing to eliminate the horizontal play present in the motor shaft which changes the paddle to wall spacing. A preliminary version of this machine did not have the
thrust bearing and the vibration of the motor made adjustment difficult.

A very good surface polish has been obtained with this machine, in about two hours, on spheres of Yttrium Iron Garnet with diameters between 0.3 and 2 mm. Also a number of spheres have been polished at the same time with no adverse effects.

Similar results have been obtained by using a more pliable paddle (thickness 0.25mm) which is slightly larger than the diameter of the cavity so that the paddle presses against the cavity wall. With this type of paddle the polishing is even faster because the sphere is pressed into the abrasive by the paddle. However the adjustment of the paddle, in this case, is more critical since to strong a pressure will inhibit the rotatory motion of the sample and cause a flat spot to develop.

BIBLIOGRAPHIE


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Fig. 1 - Schematic drawing of sphere polishing cavity