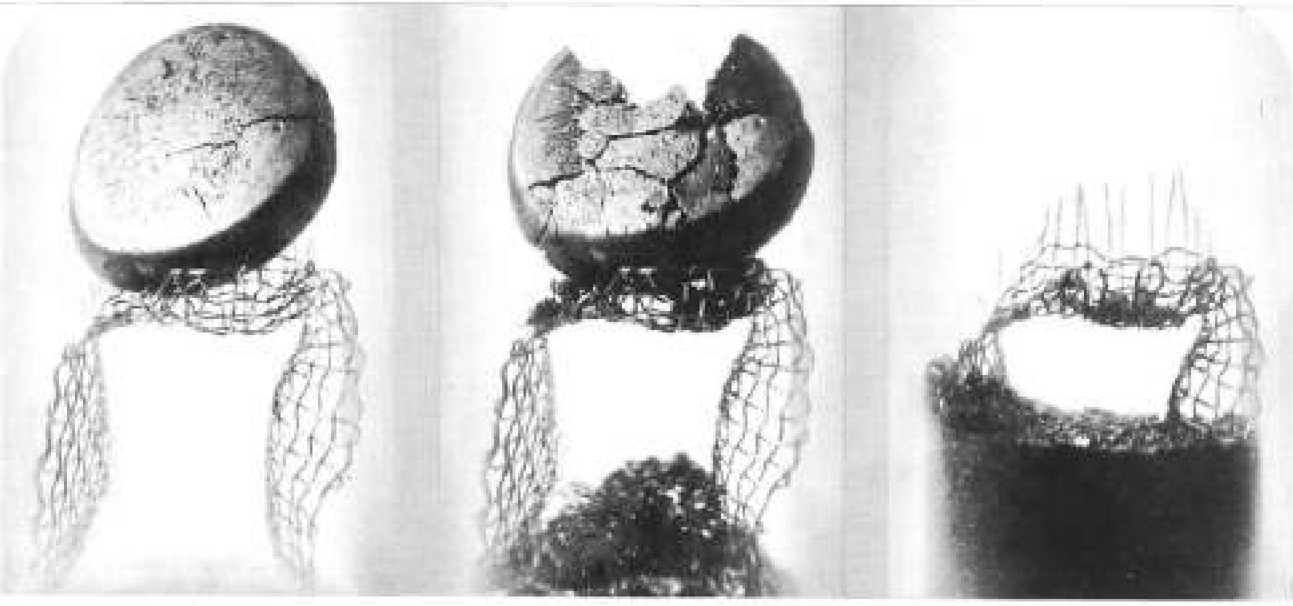
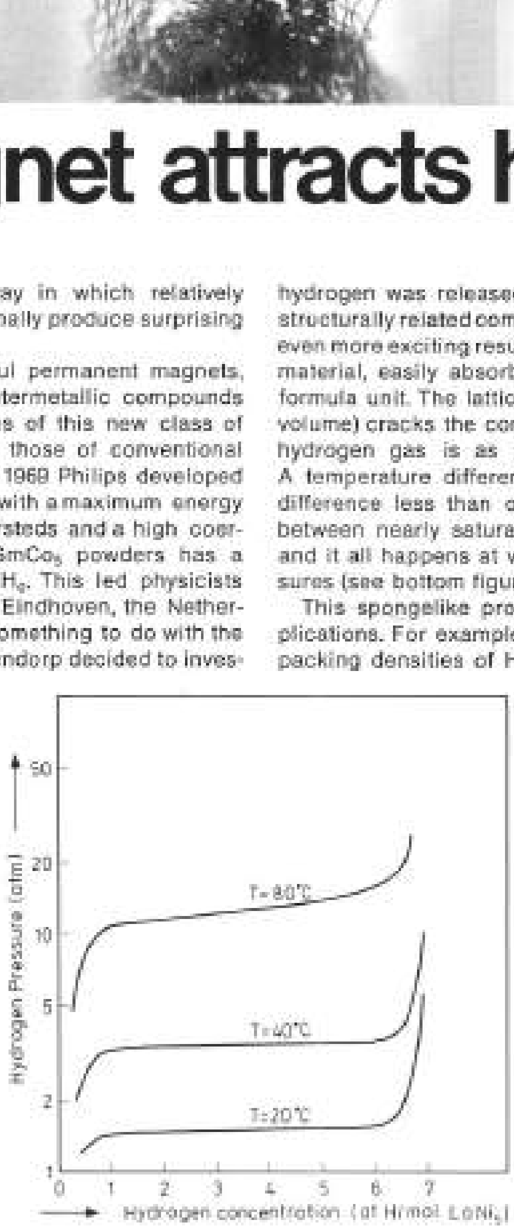


Our magnet attracts hydrogen

This is another example of the way in which relatively straightforward experiments occasionally produce surprising results.

In the research for more powerful permanent magnets, scientists have recently turned to intermetallic compounds like cobalt-rare earth. The properties of this new class of materials are markedly superior to those of conventional permanent magnets. For example, in 1969 Philips developed a samarium-cobalt ($SmCo_5$) magnet with a maximum energy product $(BH)_{max}$ of 20×10^6 gauss-oersteds and a high coercivity (10000 oersted). Etching of $SmCo_5$ powders has a noticeable effect on the coercivity H_c. This led physicists from Philips Research Laboratories, Eindhoven, the Netherlands, to believe that hydrogen had something to do with the H_c. So Dr. H. Zijlstra and Dr. F. Westendorp decided to investigate the coercivity in pressurized hydrogen. A sample of powdered $SmCo_5$ was compressed into a solid cube. This was enclosed in a thin stainless-steel tube. When the sample was subjected to a pressure of 20 atm. at room temperature, the scientists were surprised to find that the change in coercivity was much larger than they had expected; in fact it decreased by a factor of 10. Further experiments showed that large numbers of hydrogen atoms penetrated the lattice structure of the sample, transforming the original hexagonal structure into a hydride of orthorhombic structure, $SmCo_5H_{2-3}$. When the pressure was reduced, the coercivity regained its initial value and the absorbed hydrogen was released. Pursuing this line of research with structurally related compounds like rare earth-nickel revealed even more exciting results. $LaNi_5$ in particular, a non-magnetic material, easily absorbs more than 6 hydrogen atoms per formula unit. The lattice expansion that goes with it (25% in volume) cracks the compressed pellet (see top picture). The hydrogen gas is as readily released as it is absorbed. A temperature difference of a few degrees or a pressure difference less than one atmosphere spells the difference between nearly saturated absorption and near desorption and it all happens at very practical temperatures and pressures (see bottom figure).



This spongelike property comes in handy for many applications. For example storage of hydrogen, for which the packing densities of H atoms at room temperature can be higher than in liquid H_2, or purification of hydrogen, as no impurities can penetrate the lattice of the material.

So who cares if $LaNi_5$ doesn't attract iron? It certainly attracts hydrogen!

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