Rare-earth Information Center INSIGHT

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Superconducting Wires

Pacific Superconductors, a Division of General Atomics, announced at the 1990 Applied Superconductivity Conference at Snowmass Village, Colorado, September 24-28, that they have been successful in producing 1 km-long high temperature $RBa_2Cu_3O_{7-x}$ (1:2:3, where R = a rare earth) superconducting fibers. The fibers are 0.3 mm in diameter and are used to construct a twelve filament ribbon 0.9 mm thick by 5.7 mm wide. The 1:2:3 fibers are encased in copper in such a manner that bending does not degrade the superconducting properties. Pacific Superconductors have demonstrated this by bending the ribbons into a 15 cm diameter coil, which is capable of carrying a superconducting current of 10 amperes at 50 K. The current density, however, is still small, ~ 6000 A/cm^2 at 50 K in zero magnetic field, but the remarkable fact is that ribbons 20 m in length have been fabricated -- a big step forward in the commercial utilization of these 1:2:3 materials. In an applied magnetic field of ~200 gauss the current density is lowered by a factor of ten.

Pacific Superconductors hopes to produce ribbons with current densities of 20,000 A/cm^2 in zero applied magnetic field within a year, and to produce multi-kilometer lengths of wire. Their pilot plant production facility has the capacity to produce three kilometers of wire a month.

Maglev

Maglev -- short for magnetic levitation -- has come into the news recently on several fronts. In early September Representative Torricelli from New Jersey introduced legislation on magnetic levitation (HR 5535) in the U.S. House of Representatives. This bill creates a policy to establish a maglev transportation system, designate a lead agency and create a strategic plan. A national R & D competition for a design concept will be awarded to six groups (a one-year grant), and in the second phase two of the grantees will be awarded demonstration grants for a full scale maglev system. In addition, long term research will be undertaken by the Department of Energy to study: (1) high temperature superconducting materials and their application to maglev; (2) advance propulsion and levitation; (3) vehicle design and aerodynamics; (4) guideway design; and (5) electronic control and power controls.

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Also in the government domain, a few months earlier the Federal Railroad Administration (FRA) released a preliminary report to Congress concluding that maglev transportation systems are technically feasible in the U.S. The FRA also notes that these systems are probably economically feasible in a limited number of domestic transportation markets. Furthermore, the report predicts that by the year 2000 the U.S. could realistically transport passengers between cities using maglev trains moving at a velocity of 480 km/h (300 mph). The report concludes that the U.S. will soon need to make a choice of importing foreign technology via joint ventures or developing its own maglev technology. In view of the first paragraph, we know what Representative Torricelli's choice is.

The latest development concerns the proposed maglev line between Anaheim, California and Las Vegas, Nevada. Only one bid was submitted to build the 427 km (265 mile) line. The bidder was a consortium led by the Bechtel Corp. and they are planning to use a German permanent magnet technology rather than a superconducting maglev technology. Whether or not this project will start is anyone's guess, because the consortium's proposal of $5 billion was substantially higher than the $3.5 billion estimate of the California-Nevada Super Speed Train Commission.

One can rest assured, that in any maglev system the rare earths will play a vital role -- permanent magnets, optical devices, electronic controls, communications and possibly superconductors all involve rare earths to a certain degree.

An Eye-safe Neodymium Laser

The neodymium laser is one of the most important lasers in use today, but it has one major drawback -- its output at 1.064 μm is hazardous to the eyes and can cause serious damage to the retina. As a result the use of Nd lasers is restricted for atmospheric propagation applications. In recent years a great deal of effort has been expended to make eye-safe neodymium lasers. Recently S. K. Wong and co-workers (Defence Research Establishment Valcartier, Courcelette, Canada) have developed an eye-safe Nd:YAG laser which operates at 1.44 μm with a peak power greater than 1 MW with pulse widths of 85 ns and repetition rates up to 10 Hz. They were able to make the Nd:YAG lase at 1.44 μm by using either a non-Q-switched mode or a Q-switched mode. However, some lasing still occurs at 1.064, but this could be effectively removed from the output beam by using appropriate filters. The authors believe that the 1.44 μm Nd laser source has a good chance of being miniaturized. If successful this would open up applications in space, such as laser radar, and direct laser communications.

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