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An Experimental Approach to a Simplified Band Structure of the Rare Earth Metals*

KARL A. GSCHNEIDNER, JR.

Institute for Atomic Research and Department of Metallurgy
Iowa State University, Ames, Iowa

ABSTRACT

From specific heat data it was concluded that the normal trivalent rare earth metals have a density of states at the Fermi surface of 1.5 to 2.5 states/eV/atom. Interpretation of the Hall coefficient data on the basis of a two band model suggests that the number of holes in the 6s band varies from 0.001 to 0.040. For those rare earths which have negative Hall coefficients the density of states is found to be directly proportional to the number of holes in the 6s band. The band structures of these metals is thought to consist of a nearly filled 6s band which overlaps a 5d band containing slightly more than one electron. The 4f electrons are thought to occupy discrete energy levels or very narrow one-electron bands. From these analyses Hall coefficients were predicted for terbium, holmium and scandium from the known electronic specific heat constants.

The band structures of cerium, europium and ytterbium are different from the normal rare earth metals. γ-Ce has band structure nearly like those of the normal metals, except that the one-electron 4f band lies just below the Fermi level (0.076 eV below). This low lying band explains several unusual properties of γ-Ce. α-Ce has three overlapping bands, the 6s, 5d and the narrow one-electron 4f band. The 6s band contains about two electrons, the 5d about 1 2/3 electrons and the 4f about 1/3 electron. This model accounts for the unusually high electronic specific heat constant. Europium

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