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The Uncommon Metals

RESearch is rapidly increasing in the field of unusual metals. There are several reasons. As the demands for extraordinary properties in metals increase with the ever-growing complexity of modern technology, there is a tendency to look beyond the dozen or so tried and true common metals into the properties and alloying possibilities of the lesser known. Also, the constant search for materials to replace or supplement scarce metals encourages more attention to this newer field. It is not a small field by any means. Over 80 per cent of the known 98 elements are metals, although some are unstable, or of doubtful value as metals at present. Even discounting these, and the common metals, the remainder constitute a vast storehouse of potential metal properties from which to draw as research makes them available.

Perhaps of greatest current interest is the activity in making metals of increasingly higher purity. Frequently this results in the discovery of unsuspected properties, particularly improved ductility, which permits a metal to be formed and used on its own merits instead of being a parasite coating or alloying addition to a stronger ductile base metal. The most dramatic example probably is titanium. On finding a workable method for obtaining sufficient purity to give high ductility, the way was opened to discovery of alloys having an unusual combination of high strength, comparatively low weight, and corrosion resistance. These, with the potential abundance of the element, make titanium the most promising recruit to our list of structural metals. Zirconium is going through a similar transition, whereby its excellent corrosion resistance can be utilized in fabricated equipment. Hafnium recently has been prepared in a massive ductile form, and its properties will be explored. Pure thorium shows remarkable softness when prepared in a solid compact form.

Chromium, which has been common only as a bright, hard plating, has always been considered to be extremely brittle and unworkable. By proper purification it can now be made hot-workable, and individual

grams show remarkably good cold ductility on working slowly. Likewise, vanadium shows promise of being a useful, fabricable metal. Hot-forming of pure beryllium is making this metal useful for purposes other than for alloying.

Practically unknown as a metal because of unworkable brittleness, bismuth now can be made into extremely soft ductile wire by proper processing. Such wire makes available to the physicist and electrical engineer some interesting properties—such as changing electrical resistance with change in magnetic field strength and a rather high thermoelectric power. Also dear to the heart of the physicist is the growing development in availability and purity of some of the semiconductors, such as germanium, selenium, tellurium, and silicon, which make available diode rectifiers and transistors, among many growing applications. Research among these metals and others near the borderline between metals and nonmetals promises to furnish the key that will open the way to realization of that very worth-while dream—the practical, direct conversion of heat to electrical energy.

The protection of metals against corrosion and high-temperature oxidation by cladding or coating is becoming more important with growth of various types of jet engines and other equipment exposed to extreme temperatures. Typical of one type of solution has been the formation of a silicon-base coating on molybdenum, which in experimental work permits the molybdenum to be heated in air at 1,500° to over 2,000° C.

Rare metals which soon may not be so rare that they cannot be considered for special uses include high-melting rhenium and low-melting gallium. Like so many of the unusual metals, and the group as a whole, their importance is not so much what they can do now but how little we know about them. Thus they constitute a fruitful field of metallurgical research, of which recent developments are only an indication of what lies ahead.

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