Testimony of

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Research and Innovation to Address the Critical Materials Challenge

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Chairman Lamb, Ranking Member Weber, and Members of the Subcommittee, thank you for giving me the opportunity to appear before you today. My name is David Weiss and I am VP of Engineering and R&D for Eck Industries, Inc., located in Manitowoc, Wi. We employ 260 people in the production of aluminum castings and specialty aluminum alloys. We serve the commercial aviation market and manufacture structural castings for the military, as well as components for heavy duty hybrid powertrains.

Aluminum alloys rapidly loose strength when used at elevated temperatures (about 310° Fahrenheit or 155° Celsius). Important industrial sectors, aerospace companies, and the military require lightweight alloy castings that can operate in temperature ranges of 250-300° Celsius. Current needs in this temperature range are often being satisfied using titanium alloy castings, which are heavier and significantly more costly than aluminum alloy castings. Also, the energy requirements for production are significantly higher. The replacement of titanium alloys with aluminum alloys can reduce the overall energy consumed in the manufacture of products by 532 million BTU's per ton of material.

Because of the importance of high temperature light weight alloys Eck Industries was funded through the U.S. Department of Energy under Award No. DE-FC36-04GO14230 to develop such alloys using scandium and ceramic particles during the years 2004-2013. While the project was successful technically, the rare earth crisis of 2009-2011 made the solution unaffordable. The need for improved aluminum alloys continued to expand and Eck Industries suggested the use of cerium as a possible scandium replacement to the Critical Materials Institute (CMI) in 2015.

Cerium offered a potential solution to the rare earth supply issue, since cerium oxides and carbonates are the primary minerals in many rare earth deposits, particularly those available in the United States such as at the Mountain Pass mine in California. However, much of it is returned to the ground as waste. The development of a substantial use of cerium changes the economics of rare earth production by the beneficial use of a by-product, thereby lowering the cost of the heavy rare earths used for magnets and electronics such as dysprosium and neodymium. In discussion with CMI representatives at Oak Ridge National Laboratory, it was determined that this use of cerium would serve a role in diversifying the rare earth supply base, one of the key tasks of the CMI program.

CMI released seed research funding to determine casting characteristics and mechanical properties of Aluminum-Cerium (Al-Ce) alloy systems and it was determined that these alloy systems have excellent castability and superb high temperature properties, higher even than the Al-Sc alloys that we had previously developed. Our company continued to develop the Al-Ce system with internal funding and with the assistance of national laboratory resources provided in part by CMI. These results were published and presented. The casting purchasing community took notice, particularly after the alloy system won an R&D 100 Award in 2017. Eck licensed the technology and continued the development.

Materials development is always a complex enterprise. Potential customers look at the data, request samples, do initial evaluation and look for attributes of the material that have not been tested for or had not been considered in the original development. Commercialization requires ongoing research to make a product in volume, that meets all the customer's requirements at a cost that they can afford. We have some small customers for the material now who are early adopters and less price sensitive. We are also working with five different Fortune 100 manufacturing companies to deploy the alloy in key products for their organizations. These efforts -- industrial scale up at our company, extensive product testing by the original equipment manufacturers, and continued research to meet product-specific needs and reduced costs -- will enable successful deployment of Al-Ce alloys.

In addition to the ongoing work in cast products, we are working with CMI on the development of Al-Ce powders for additive manufacturing and powdered metal manufacturing. With customer support we have initiated a project on the blending of Al-Ce powders with silicon carbide for wear and corrosion-resistant surfaces. One of the key and unexpected findings of our joint research efforts has been the extraordinary corrosion performance of these alloys. A shipbuilder for the Navy is now testing an alloy that contains enough cerium to prevent corrosion sensitization of common marine alloys.

We have started on a new phase of research that bypasses the need to produce metallic cerium. We have demonstrated that, at laboratory scale, we can alloy aluminum with cerium through direct reduction of the cerium oxide or carbonate at a significant savings in energy and cost. As we scale this technology, we expect to be able to produce Al-Ce alloys at the same cost as conventional aluminum alloys.

Good research projects can make unexpected advances. We set out to produce an alloy resistant to elevated temperatures. We were able to do that. In addition the alloy is remarkably corrosion resistant, saves energy, and can easily be used in additive manufacturing. Our success to date has been based on several factors -- the extraordinary team of researchers that has been assembled by CMI, very strong industrial participation and a willingness to continue to support research that gets over the rough spots as our commercialization proceeds.

Thank you for giving me the opportunity to address you today.