All-domain Anomaly Resolution Office

Supplement to Oak Ridge National Laboratory's Analysis of a Metallic Specimen

July 2024

Overview

In 2022, The All-domain Anomaly Resolution Office (AARO) contracted with Oak Ridge National Laboratory (ORNL) to conduct materials testing on a magnesium (Mg) alloy specimen. This specimen has been publicly alleged to be a component recovered from a crashed extraterrestrial vehicle in 1947, and purportedly exhibits extraordinary properties, such as functioning as a terahertz waveguide to generate antigravity capabilities. In April 2024, ORNL produced a summary of findings documenting the laboratory's methodology to assess this specimen's elemental and structural characteristics, available on AARO's website.

ORNL assessed this specimen to be terrestrial in origin and that it does not meet the theoretical requirements to function as a terahertz (THz) waveguide. AARO concurs with ORNL's assessment and provides this supplementary material to add historical context to account for its likely origin. The specimen's characteristics are consistent with Mg alloy research and development projects and experimental manufacturing methods in the mid-20th century.

ORNL Materials Testing

AARO contracted with ORNL to conduct materials measurements to determine:

- Whether this specimen is of terrestrial origin.
- Whether this specimen could serve as a THz waveguide.

ORNL measured the isotopic ratios of Mg and lead (Pb) in the specimen and compared the values against mass standards. A material's isotopic composition can provide valuable information about its origin and history. The specimen's Mg isotopic composition falls within the expected values for a terrestrial material that has undergone kinetic fractionation, suggesting likely terrestrial origin. Its Pb isotopic ratio is consistent with ratios found in terrestrial lead, further supporting this conclusion. ORNL found the isotopic composition of this material to be unremarkable. The specimen's Mg and Pb ratios fall within the standard values for manufactured materials, indicating that it is not a unique or unusual material.

Elemental and structural analysis can help determine whether a structure has the characteristics of a waveguide. A waveguide is a structure that bounds and directs the propagation of waves. Waveguides are instrumental to many technologies. ORNL measured the specimen's top layer's elemental composition and crystal structure and found bismuth (Bi) colocated with nearly equal parts Pb. High-resolution elemental mapping shows repeating layers of Bi and Pb banding throughout the specimen and zinc (Zn) concentration varying from 1-4 wt%. Structural analysis shows columnar Mg grains perpendicular to the Bi and Pb banding.

According to *Podolskiy et al.*, Bi can theoretically function as a waveguide when it exists as a single crystalline layer between surfaces with sufficient dielectric (ε) constants.[1] As a single crystalline layer, Bi displays anisotropic ε properties.[2] Anisotropic ε properties cause electromagnetic waves to propagate non-uniformly across different axes. *Podolskiy et al.* assert that a monocrystalline layer of Bi has sufficient ε anisotropy to guide THz frequency waves. This specimen's intermixed composition of Pb indicates that Bi never existed as a pure layer, regardless of any processing effects that may have altered the crystalline structure. Therefore, this specimen's elemental and structural characteristics do not meet the conditions to theoretically function as a waveguide.

ORNL and AARO could not determine whether this specimen was a fragment of a larger object. However, this specimen's delamination, oxidation, and structural characteristics are consistent with exposure to environmental and mechanical stresses over time.[3] In its current form, the specimen probably does not represent its original configuration, condition, or application. Despite these complicating factors, AARO draws two distinct conclusions from ORNL's findings:

First, the specimen's physical properties are consistent with a material of terrestrial origin. Materials exhibit a predictable isotopic signature when formed in and exposed to terrestrial conditions. This specimen's isotopic signature is consistent with terrestrial signatures and does not exhibit expected interstellar signatures.[4] [5] [6] [7] [8]

Second, the specimen's structural and elemental properties are inconsistent with the anisotropic ε properties required to theoretically function as a waveguide.[2]

Historical Context and Likely Origin

Starting in 1915 and peaking during World War II, there was widespread domestic research on Mg alloys for airframes, engines, weapons, and delivery systems. At the time, researchers did not fully understand Mg corrosion and other failure mechanisms. [9] [10] [11] Many projects studied magnesium-zinc (Mg-Zn) alloys with 1-4 wt.% Zn in Mg.[12] [13] [14] Other projects studied the impact of Pb and Bi additives on Mg alloys for corrosion resistance. This research found that Pb and Bi would concentrate at the surface due to lower surface tension, consistent with the banding seen in this specimen.[15] The specimen's grain structure, Zn concentration, and banding of Bi/Pb are also consistent with out-of-equilibrium processes, such as vapor deposition in a vacuum chamber that may have contained impurities. Before 1970, vapor deposition manufacturing techniques were not fully mature, and achieving pristine thin films remained challenging.[16] [17]

Research, development, testing, and evaluation is an iterative process of trial and error. This process subjects test objects to conditions designed to evaluate material limits and identify modes of failure. Historically, the scientific community has not extensively documented failed experiments. Many experimental Mg alloys failed for reasons not well understood at the time of testing, e.g., stress corrosion cracking. [18] [19] [20] [21] Unsurprisingly, records of failed Mg alloy designs are scant. Neither AARO nor ORNL could verify the specimen's historical origin. Unverifiable, conflicting personal accounts complicate its undocumented chain of custody. Regardless of the specimen's attributability to a specific research project, it is consistent with well-documented Mg alloy research projects during the mid-20th century and is otherwise unremarkable.

Conclusion

AARO concurs with ORNL's findings that the specimen's isotopic composition indicates terrestrial origin. AARO also concurs with ORNL's findings that its physical and elemental properties are incompatible with functioning as a THz waveguide. Considering all available evidence, AARO assesses that this specimen is likely a test object, a manufacturing product or byproduct, or a material component of aerospace performance studies to evaluate the properties of Mg alloys.

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