Docket #: S20-509

Inexpensive, wear resistant metallic glass coating

Stanford researchers have discovered a new class of metallic glass alloys with superior properties such as low cost, high wear resistance, and electric conductivity comparable to graphite. These metallic glass alloys are made from inexpensive materials (FeNbB) and are 4x harder and nearly 2x more wear-resistant than stainless steel. Additionally, these advanced materials are non-toxic and can be sputtered on to a surface at room temperature.
Machine-learning guided, high-throughput experimentation (ML-HiTp) was used to discover these enhanced metallic glasses in the Fe-Nb-B ternary. This invention illustrates how this approach can improve on best-known materials and quickly lead to superior ones in highly complex composition-processing spaces. This machine-learning guided procedure is not limited to just finding wear-resistant multiple principal element alloys (MPEAs), but can be readily applied to searching the vast processing-composition MPEA combinatorial for other desired materials.

Figure

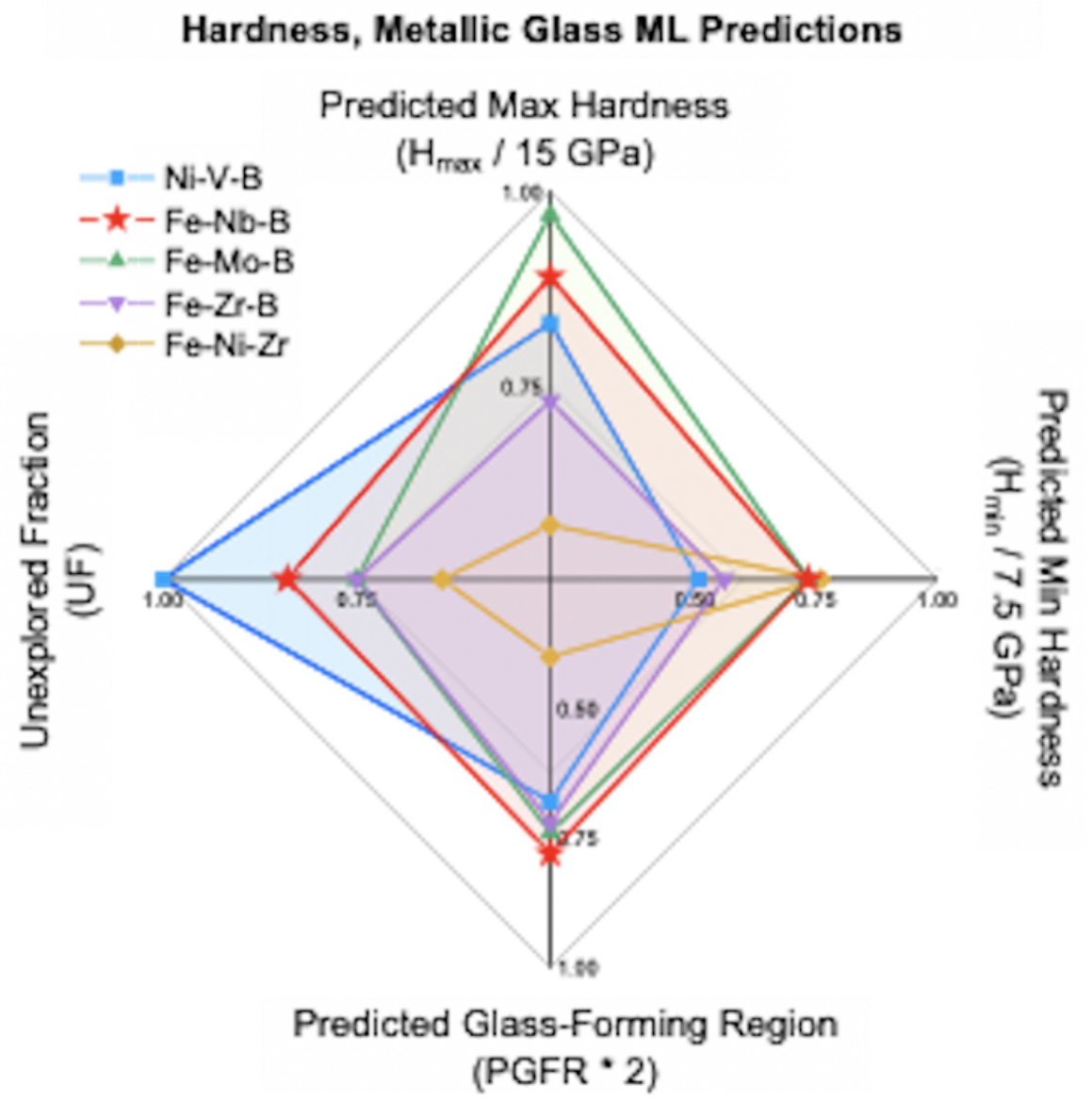

Figure description - Top 5 candidate MPEA ternary systems for exploration. Each axis represents 4 desired characteristics of 5 ternary systems (individual axis are normalized 1 to reduce complexity of the plot).

Image Credit-inventors

Stage of Development

- Proof-of-concept
- Next step is to make coating with industrial partner

Applications

- **Hard surface coating on commercial products** including but not limited to cutting surfaces (e.g. knives to machine tools) and contact surfaces (e.g. electrical connectors and brushes in electrical motors)
- Can be applied to any hard product to reduce wear and tear

Advantages

- **Inexpensive** - made with low cost materials, FeNbB
- **Non-toxic, earth friendly materials**
- **High wear resistance** – these new class of metallic alloys are 4x harder and nearly 2x more wear-resistant than stainless steel
- **Room temperature processable**
- **Prolongs life of product** due to less degradation from wear and tear
- Demonstrates how application of **machine-learning-guided high throughput experimentation** can improve on best-known materials and quickly lead to superior ones in highly complex composition-processing spaces

Publications

- Sarker, Suchismita, et al. "Discovering exceptionally hard and wear-resistant metallic glasses by combining machine-learning with high throughput experimentation." *Applied Physics Reviews* 9.1 (2022): 011403.

Patents

- Issued: 11,827,965 (USA)

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