Knowledge Transfer Office
香港城市大學
City University of Hong Kong

# Technology Brief of CityU's IP

## Ultra-elastic Chemical Complex Alloys with Extraordiinary Elinvar Effect (IDF# 935, US 17/209,589)

[Ref.: https://arxiv.org/ftp/arxiv/papers/2101/2101.02382.pdf ]

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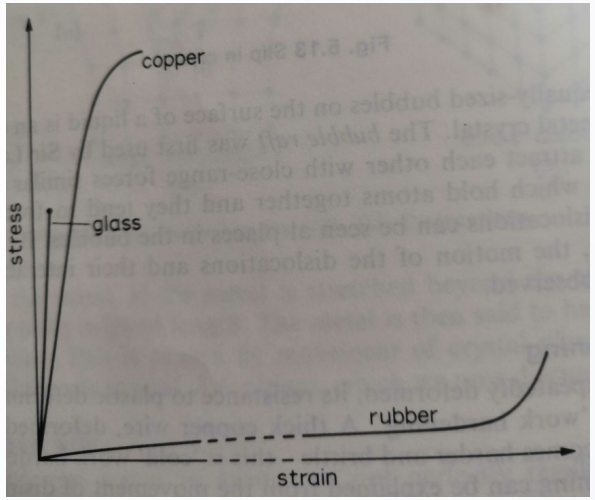
# Ultra-elastic Chemical Complex Alloys with Extraordinary Elinvar Effect

**Background:**

What is Elinvar alloys?

- An alloy of Nickel–Iron–Chromium (originally)
- Modulus of elasticity does not change with Temperature
- $E \equiv \frac{\sigma(\varepsilon)}{\varepsilon} = \frac{F/A}{\Delta L/L_0} = \frac{FL_0}{A\,\Delta L}$ $\neq$ $\triangle$T



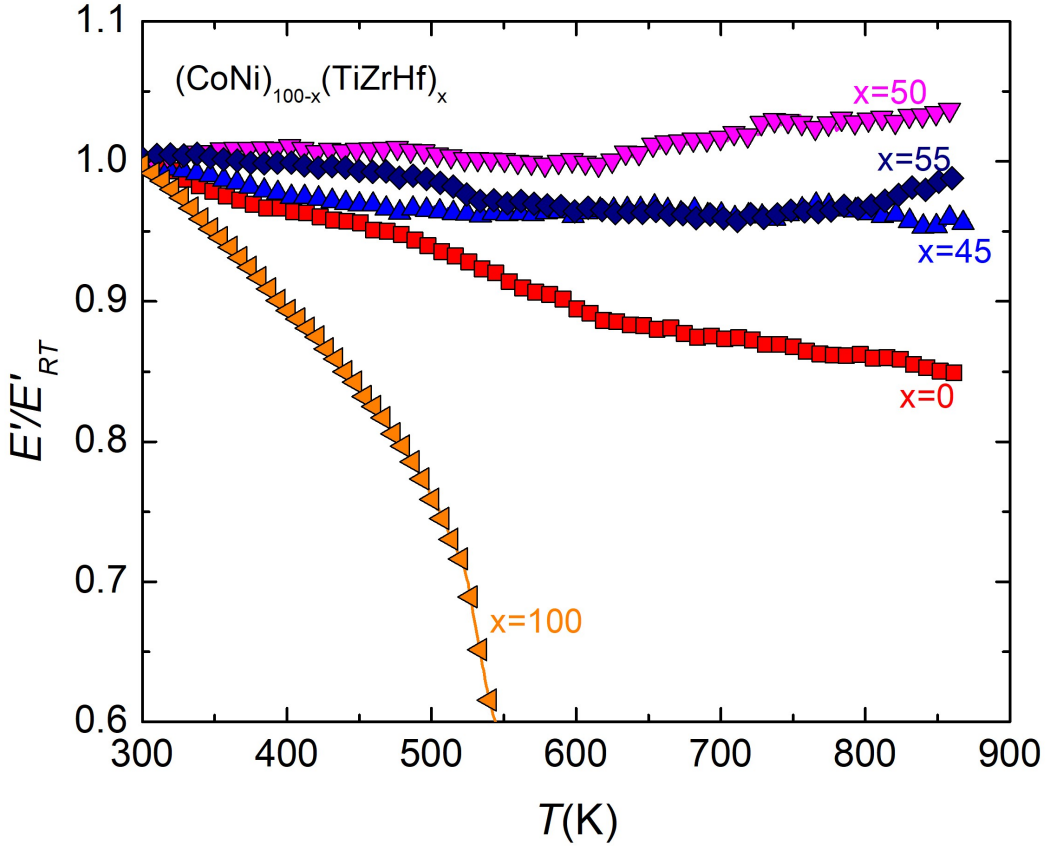

- Invented by Charles Édouard Guillaume, a Swiss physicist, won the 1920 Nobel Prize in Physics for the discovery
- Largest use in balance springs for mechanical watches and chronometers

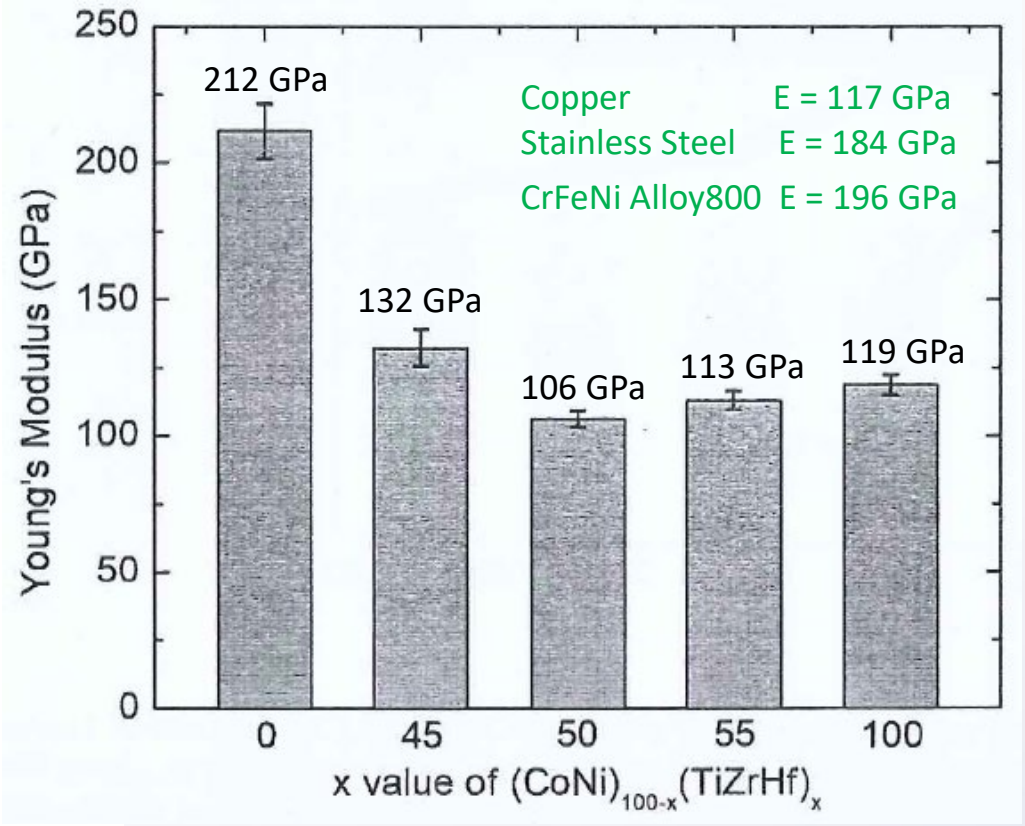
[Source: Wikipedia.org]

# Ultra-elastic Chemical Complex Alloys with Extraordinary Elinvar Effect

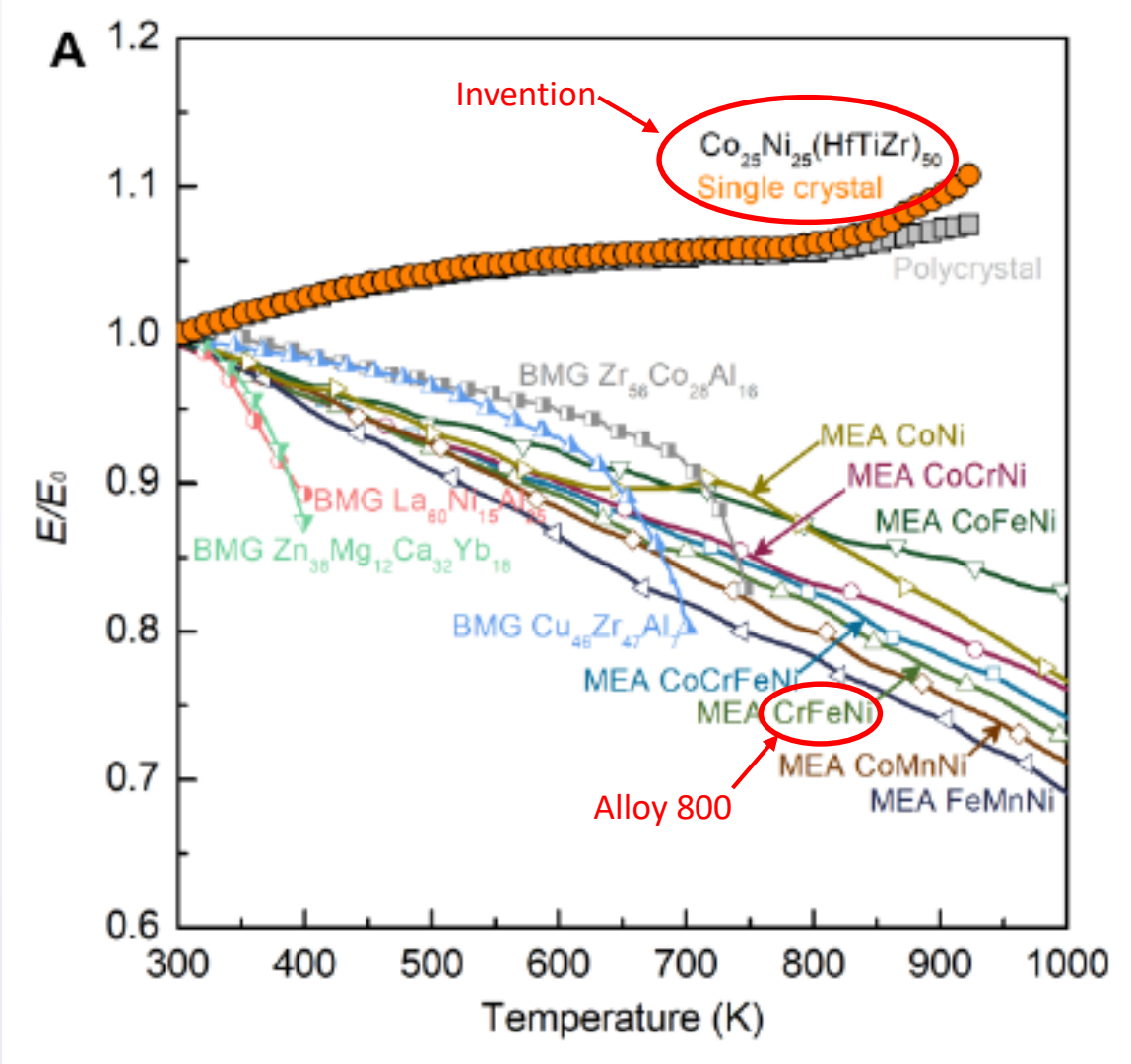
**Technology:**

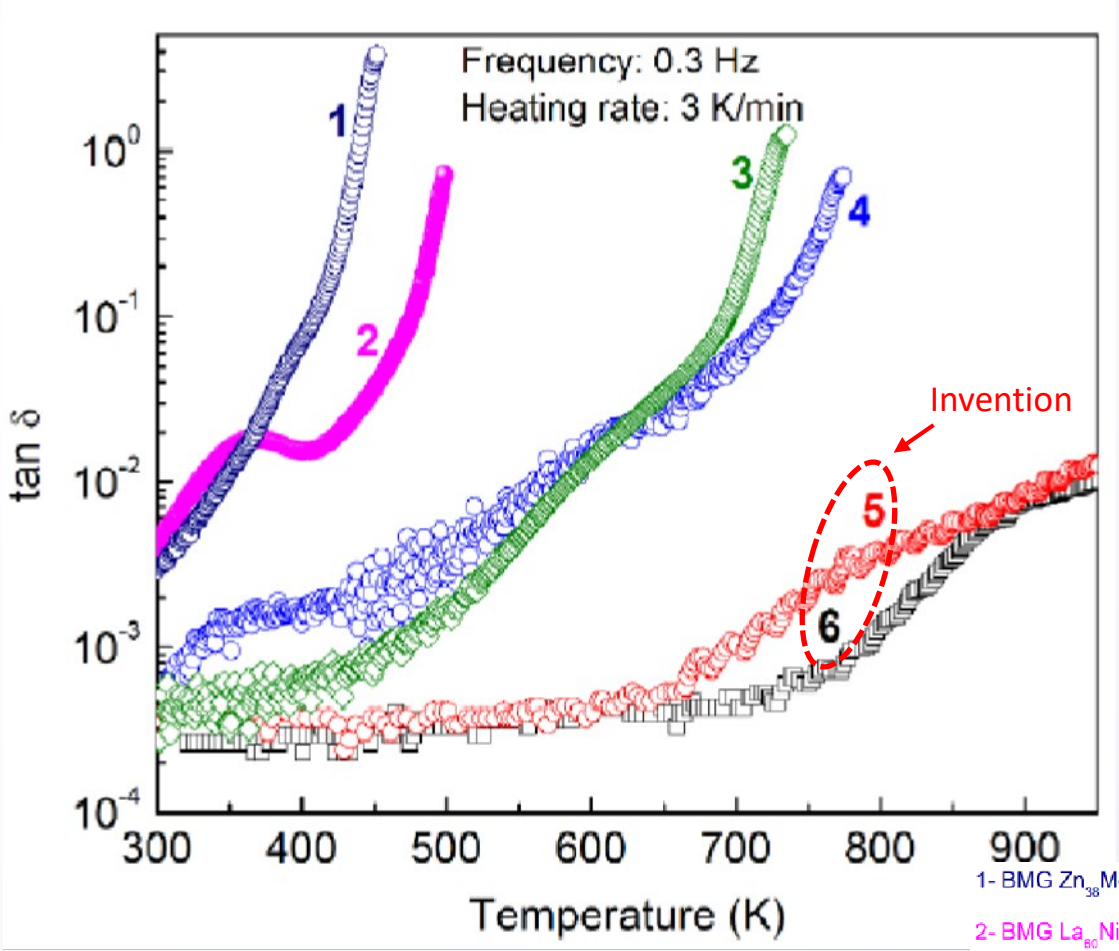
- A series of the High-Entropy Alloy of **$(Co\ Ni)_{100-x}(Ti\ Zr\ Hf)_x$** where $45<x<55$



# Ultra-elastic Chemical Complex Alloys with Extraordinary Elinvar Effect




Mechanical Loss Factor (tan δ)
(A material dissipates vibration energy)

1- BMG $Zn_{38}Mg_{12}Ca_{32}Yb_{18}$
2- BMG $La_{80}Ni_{15}Al_{25}$
3- BMG $Cu_{46}Zr_{47}Al_7$
4- BMG $Zr_{55}Co_{28}Al_{16}$
5- $Co_{25}Ni_{25}(HfTiZr)_{50}$ (Polycrystal)
6- $Co_{25}Ni_{25}(HfTiZr)_{50}$ (Single crystal)

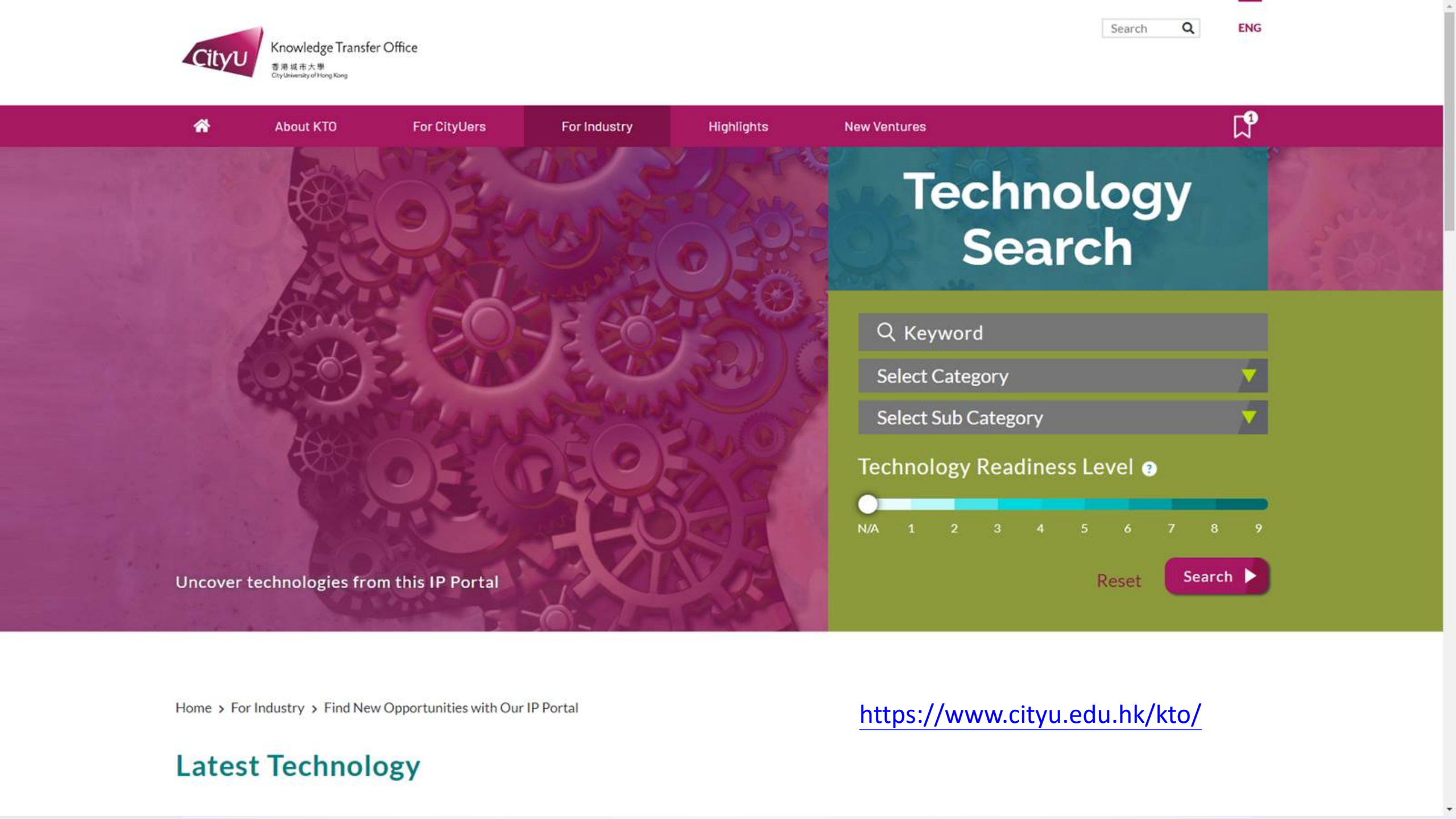
# Ultra-elastic Chemical Complex Alloys with Extraordinary Elinvar Effect

**Advantages:**

- Strong Elinvar effect with wide range of ambient temperature
- Large elastic strain limit without limitation in dimension scale
- High efficiency of energy storage with very small internal friction
- Good fluidity and easy for fabrication

**Applications:**

- Chronometers, Precision devices & Calibration instrument
- Medical equipment, Combustion engine, Power plant, Aerospace & Military
- Applications at harsh ambient condition

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## Latest Technology

# Thank you!

# Q & A