Shape Memory Alloy Actuator with Sharp Phase Change
Technology #14841

Applications

This invention can be used for backflow prevention in an artificial gas lift valve - as used in oil production. Due to its dependence on only thermal signals, its few moving parts, and its lack of battery requirements, the new apparatus is practical and reliable in many process and flow control scenarios.

Problem Addressed

Based on commercially available Shape Memory Alloy (SMA) wire material, current thermally-actuated gas valves require a gas-oil temperature difference of at least 6°C to completely actuate. Therefore, current safety valve design could not be applied to wells that experience less than 6°C gas-oil temperature difference. This invention will allow thermally activated devices, such as fluid control valves, to become much more sensitive (up to 1°C) to temperature differences.

Technology

This invention uses a SMA element attached to a valve body, which allows the valve to move between the first and second positions according to a threshold amount of temperature change unique to the shape memory alloy element. This invention also describes a way to decrease the temperature difference required for the SMA wire to fully actuate. The SMA wire actuates when it is heated from As (Austenite Start Temperature) to Af (Austenite Finish Temperature), which are both dependent on the stress applied to the wire. Higher stress increases both As and Af, while lower stress decreases both. By specifically controlling stress in the wire, the As and Af temperature difference can be decreased. This is achieved with a negative differential spring. Commercially viable springs can be hardened to decrease the amount of force that it produces as it is displaced, and thus increasing As and while decreasing Af.

Advantages

- Allows for full actuation of SMA wires with a lower gas-oil temperature difference
- No battery or communication dependence
- Few moving parts

Categories For This Invention:

Energy
Hydrocarbons
Oil Exploration
Materials
Micro & Nanotech
Shape Memory Alloy Structures
**Intellectual Property:**
Sharp-phase change shape memory alloy thermal actuator
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**External Links:**
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http://oceans.mit.edu/people/all-oceans-people/by-subject/engineering/name/franz-hover

**Image Gallery:**

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