Category: **Chemical and Material Sciences**

**Glass Inks**

Thin films printed with chalcogenide glass inks

**Problem Statement**

Radiation hard temperature sensors are desirable for many applications. These sensors are more specifically useful in hostile environments where heat, radiation, or a combination of both, may prevent human contact with a sample to be measured. Particular applications for these sensors may include space exploration, high temperature manufacturing processes, and others. At space exploration, the application of standard thin film deposition equipment, due to its size and weight, is not feasible and thus introduction of printing is a useful practical solution. Besides the smaller and lighter equipment used for printing, a major benefit of its application is the fact that no photolithographic process is necessary for device formation. Depending upon the ink (based on powder or chemical solution) the resolution of the printing method can result in formation of devices with very fine features.

**Technology Overview**

Chalcogenide glasses are resistant to radiation and some chalcogenide glasses may be stable at relatively high temperatures. They may also include electrical, and optical properties that can be helpful for temperature measurements and in combination with high diffusive silver, for radiation measurements. This patent describes a method using additive manufacturing for printing a chalcogenide glass layer. Due to the specific properties of the material usually this is the active layer of the devices based on chalcogenide glasses. At the printing process, the device features are obtained directly during the film formation and there is not a need for a following photolithographic process for their imaging. The same printing method can be applied for adding electrodes, if necessary, using existing metal solutions.

**Applications:**

The temperature and radiation sensors can be used in hostile environments where heat, radiation, or a combination of both, may prevent human contact with a sample to be measured. Chalcogenide glasses are also important materials used for phase change or programmable metallization cell memory devices, display pixels, which all are radiation stable. One immediate application is a radiation sensor based on the diffusion of silver ions in chalcogenide glass under radiation or temperature sensor based on crystallization of the material. The device formation of all sensors or memory devices is easy, fast and requires light, small and cheap equipment.

**Benefits:**

Typical chalcogenide glass film formation may be performed using vapor deposition processes. These processes may rely on expensive, weighty, and specialized equipment to perform and require the application of a photolithography process for devices formation. Further, vapor deposition processes combined with photolithography may be too costly to justify in some applications. These processes are also time-intensive and may make mass production of chalcogenide glass sensors unfeasible. Additive manufacturing or printing may have many advantages over traditional manufacturing processes, such as direct device formation, lower costs, higher throughput, and high conformity. No photolithographic process included and no heavy equipment, which could be especially important for space missions when the weight and size of the equipment for device formation is of a great importance.



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