Researchers at the University of South Florida have developed a method to control thermoelectric flow and obtain a thermoelectric cloak without disturbing the coupled external heat and electric currents under any boundary conditions.

The ability to control electromagnetic fields, heat currents, electric currents, and other physical phenomena by coordinate transformation methods has resulted in novel functionalities, such as cloaking and field rotations. These methods rely on transformation optics, with most applications and designs being limited to functionalities within one physical domain. In order to provide optimum use and flexibility in fields of application, there is a need to use these transformation methods across multiple domains.

USF researchers have developed a novel method to create a thermoelectric cloak capable of hiding objects from thermoelectric flow. This method is independent of any boundary conditions and can operate in different single domain regimes. The cloak also does not disturb the coupled external heat and electric currents. To achieve this, transformation optics are applied to thermoelectric phenomena, where thermal and electric flows are coupled via the Seebeck coefficient and Joule heating is taken into account. Laminate metamaterials are constructed using bilayer composites to achieve the cloaking. This technology provides a significant step forward towards finding unexplored ways to control and manipulate coupled transport.

**ADVANTAGES:**
- Bi-functional cloak
- Independent of boundary conditions
- Ability to operate in thermal as well as electric regimes

**Metamaterials that can Form Thermoelectric Cloak**

**Thermoelectric Cloak Makes the Region of Circle Invisible**

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