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# Topographically conforming self-fitting garments made of active materials

A method to design and manufacture knitted garments that dynamically conforms to complex surfaces.

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## Applications

- Consumer, athleisure garments
- Gaming and VR devices
- Medical wearables - therapeutic devices, body sensors
- Compression garments
- Soft-robotics
- Wearable technologies

## Key Benefits & Differentiators

- **Total topographical conformation** without using undersized elastic material or closure devices
- **Uniform compression fabric** for creation of comfortable consumer garments and effective medical wearables
- Body-heat activated fitting to complex, unique body shapes
- Design garments without physical devices to create proper fitting

## Revolutionary self-fitting garments made of active materials

Conventionally, garments are made to fit complex body shapes using undersized elastic garments and/or closure devices such as braces, ties, cuffs, etc. Undersized garments can be too tight or too loose, and rely on a few contact areas on the wearer’s body where tension can be applied, resulting in poor aesthetics. Closure devices, on the other hand, can add to manufacturing complexity and diminish the overall aesthetics. Conventional fabric and fastening mechanisms are even more unfavorable in medical wearables, where both uniform compression and continual contact to moving wearer’s body is often necessary; utilizing

molding technique or foam inserts to address this problem has been ineffective and laborious.

Researchers at the University of Minnesota have developed a new method to create self-fitting fabrics that can conform over complex surfaces such as the human body while maintaining constant compression. This fabric, made by knitting filaments of NiTi-based active materials, can be programmed to shape-shift and conform to remain in continual contact with the wearer's body even while the wearer is moving/changing postures. In this invention, conformity around concave and convex surfaces is achieved by creating spatially varying functional properties through intelligent combination of different knit patterns. The ability to architecture functionally graded active fabric based on knitting pattern and material properties offers a level of unparalleled resolution in creating topographical conformation to highly complex surfaces.

This advanced materials and systems invention

- enables novel garment manufacturing and application strategies,
- facilitates topographical fitting by spatial actuation through garment architectural design, and
- presents active material compositions to enable actuation on the surface of human skin.

## Phase of Development

Multiple topographically self-fitting prototypes have been fabricated and validated using
- high-temperature active material for test rigs of different body parts, and
- body-heat actuated active material for the wrist.

**Researchers**

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**Publications**

*Functionally Graded Knitted Actuators with NiTi-Based Shape Memory Alloys for Topographically Self-Fitting Wearables.*
*Advanced Materials Technologies (2019).*

**Ready for Licensing**

This technology is now available for license! The University is excited to partner with industry to see this innovation reach its potential. Please contact us to share your business’ needs and your licensing interests in this technology. The license is for the sale, manufacture or use of products claimed by the patents.

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