How Electric Fields Can be Used to 3D-Print Hydrogels, Burst Capsules, and Stick Gels to Tissues

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This talk will show how electric fields can induce a rich variety of behavior in soft materials that contain water (e.g., hydrogels and capsules).

- First, I will describe how gels of biopolymers can be created in 3D using an electric field. The biopolymer is gelled at a precise location by applying the field through a fine electrode. By moving the electrode in 3D space, we can build a gel in a specific shape.
- Next, I will move on to soft microcapsules made from biopolymers. When these capsules are placed in aqueous solution and subjected to an electric field, they deform and burst [1]. These electroresponsive containers could be used to deliver drugs in wearable devices.
- Lastly, I will discuss the electroadhesion (EA) of cationic hydrogels to animal tissues [2, 3]. We are using this technique to perform surgeries without using sutures.

References:

[1] A. Gargava, W. Xu and *S. R. Raghavan**
Electrically induced bursting of aqueous capsules: 'Switching on' the release of payloads.
Advanced Functional Materials, **2022**, *32*, 2206029.

[2] L. K. Borden, A. Gargava and S. R. Raghavan
Reversible electroadhesion of hydrogels to animal tissues for suture-less repair of cuts or tears.
Nature Communications, **2021**, *12*, 4419.

[3] L. K. Borden, A. Gargava, U. J. Kokilepersaud and S. R. Raghavan
Universal way to "glue" capsules and gels into 3D structures by electroadhesion.
ACS Applied Materials & Interfaces, **2023**, *15*, 20014.

Biography of Srinivasa R. Raghavan

Srinivasa (Srini) Raghavan received his B.Tech. and Ph.D. in Chemical Engineering from the Indian Institute of Technology, Madras, and North Carolina State University, respectively. His research has resulted in more than 190 publications and 20 patents, which have been cited more than 18,000 times (h-index of 75). At UMD, he has been recognized both for his teaching and his research, including being designated a *Distinguished Scholar-Teacher* in 2017. He has been a four-time nominee for a UMD *Invention of the Year* and won this award in 2009 and 2022. He is also the scientific co-founder of four startup companies based on technologies invented in his laboratory.