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Additive manufacturing for health care & soft robotic applications using silicone elastomers

Manufacturers of medical devices and soft robotics use silicone materials to design a wide range of products, such as tubing and drains, drug delivery systems, pacemakers & valves, vaginal rings, hearing aids, pneumatic actuators, etc. Silicones used in medical devices must be biocompatible, reliable, precise, flexible and durable, efficiently ensuring the protection of sensitive components from corrosive body fluids. Silicones used in soft robotics must be with high stretch ability, and able to be sollicitated in infinite number of cycles. This presentation will introduce the new challenges and benefits of additive manufacturing (AM) to make personalized silicone elastomers for medical devices and soft robotics. Due to their low elastic modulus and poor shape retaining ability during the layer-by-layer process, silicone elastomers AM could be technically challenging and a good understanding of the relationships between input and output parameters during the AM is key. Mastering such parameters along with the 3D printer machine and the silicone chemistry has allowed us to predict the aspect but also the mechanical behavior and performances of the 3D printed part. As an example, 3D-printed silicone elastomer medical devices or actuators combining complex shapes, high overhangs and mechanical performances can be now obtained in one shot process with one or several products for such domains. The results as implants and actuators fit perfectly with the functional needs. The AM of silicone elastomeric materials open the door also to multi materials since silicone elastomer AM is also progressing very fast with the use of new reliable, accurate, printing equipment. It is also essential to get a high level of performance since the question of qualification of the full chain of medical device manufacturing which comply with regulatory issues is key for the future of this industry.

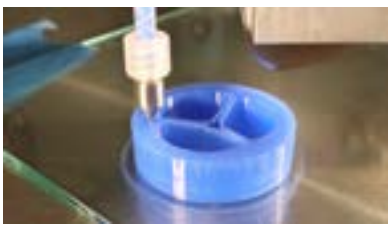

Figure 1: One example of 3D printed silicone object designed for printing valves

Biography

Jean-Marc Frances has graduated from the National School of Chemistry of Toulouse (today ENSIACET, France) in 1981 and Doctor Engineer in Chemistry in 1983. He has spent his industrial career at Rhône-Poulenc and Rhodia before joining Bluestar Silicones in 2007 now Elkem Silicones since 2017. He is Technology & Scientific Coordinator for Elkem Silicones R&D, Director of incubator projects fueled by Open Innovation. In such position, he has been working on one main industrial challenge which is the development of the additive manufacturing processes with silicones.

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