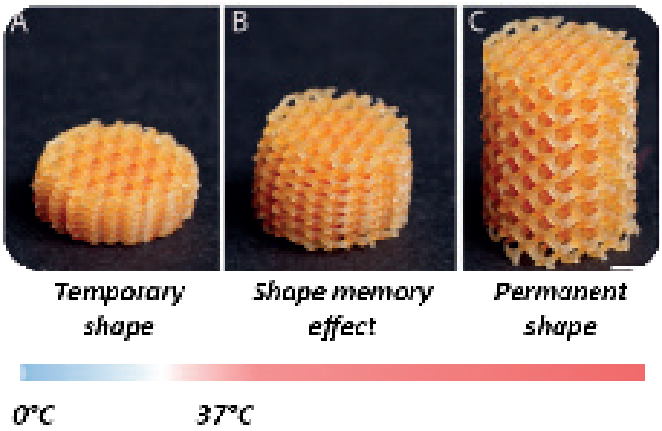
# "SMART" POLYMERS
## for 4D printing

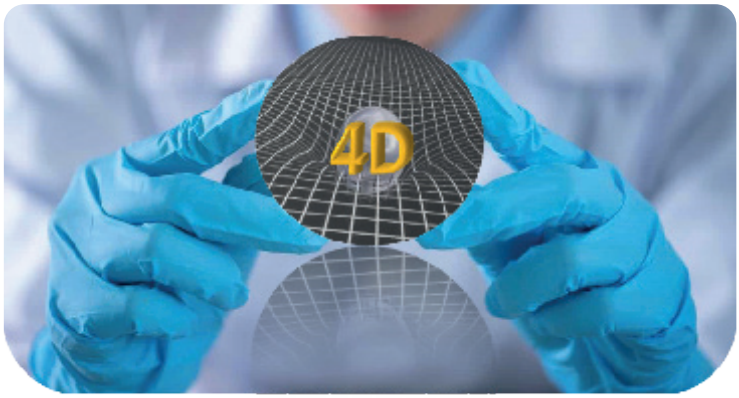
Additive manufacturing is perceived as a real industrial revolution.
Constant developments in manufacturing techniques and types of materials – notably stimuli-responsive polymers – have contributed to the emergence of 4D printing technology.
This new approach enables a 3D printed object to change over time in a controlled manner in response to external stimuli.

**Carnot Balard Cirimat Chemical Institute**

## Scientific / technological breakthrough

Carnot Balard Cirimat Chemical Institute (ICGM-D2) is working on «smart» polymers used in additive manufacturing. Their development has turned 3D additive manufacturing into a reality and enabled researchers to push on towards 4D printing. But this technology is still very new and there is growing demand for smart, stimuli-responsive 3D polymer objects that can be produced using 4D printing. To meet this demand, Carnot is developing stimuli-responsive polymer-type materials (hydrogel, elastomer, biodegradable, biosourced, etc.) that can generate shape memory, self-healing, actuator, swelling effects, etc.




## Competitive advantage for the economic stakeholders

4D printing is a significant step forward for additive manufacturing and will play a key role in the industry of the future, especially in healthcare. Research into the global 4D printing market has highlighted significant growth in the biomedical sector. It is expected to account for 29.8% of the biomedical market, representing a jump in investment from $4.7 million in 2019 to $39.3 million in 2027.
As additive manufacturing has moved far beyond the boundaries of medicine, 4D printing can also look to an extremely promising future in the energy, aerospace and environmental sectors.

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