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ADDITIVE MANUFACTURING OF INTELLIGENT MATERIALS: SIMULATIONS AND EXPERIMENTS

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ABSTRACT

Intelligent materials and systems are capable of sensing stimuli from their surrounding environment, and performing actions or undergoing internal adaptation in response to such stimuli [1]. In nature many biological systems have developed such capabilities. Instead, fully responsive and robust, intelligent artificial systems are still challenging, and require the use of smart materials in complex, three-dimensional (3D) architectures featuring dynamic properties. For these reasons, integrating stimuli-responsive materials in structures and devices realized by additive manufacturing (AM) is highly important. To this aim, advanced AM processes have to be designed and developed to preserve the properties of smart molecules and nanomaterials during the fabrication, enabling the production of components with dynamic properties and sensing/actuation properties addressing photonic [2], electronic, structural, or biological functions.

This Session aims at stimulating the establishment of an interdisciplinary platform for the community of scientists and engineers, in order to exchange knowledge in smart materials, AM processes and device design, and promote closer collaboration and potential advances of artificial intelligent systems made by AM. The Session will bring together researchers from different fields, such as materials science, physics, chemistry, engineering and biology, and stimulate cross-disciplinary theoretical and experimental research efforts to identify and overcome current challenges of AM for intelligent materials.

Original technical and scientific contributions are solicited on, but are not limited to, the following topics:

- Multiphysics modelling of AM processes involving stimuli-responsive materials and functional compounds/blends (e.g., photopolymerization kinetics, light propagation, ink rheology, electrohydrodynamic jets).

- Intelligent materials for 3D printing processes.

- 4D printing processes.

- Optically-, electronically-, or biotechnologically-relevant properties of nanomaterials responsive to physical stimuli.

-Design and fabrication of smart components, devices and systems by additive manufacturing.

REFERENCES

[1] Kaspar C., Ravoo B.J., van der Wiel W.G., Wegner S.V., Pernice W.H.P., The rise of intelligent matter, Nature, Vol. 594, 345-355 (2021).

[2] D'Elia F., Lavista L., Orsini S., Camposeo A., Pisignano D., *All-optical processors by 3D printable photochromic materials*, Light: Science & Applications, Vol. 14 (1), 375 (2025).