nanomanufacturing

MDPI

Editorial

Nanomanufacturing: There's Still Plenty of Room at the Bottom

Andres Castellanos-Gomez

Instituto de Ciencia de Materiales de Madrid (ICMM-CSIC), E-28049 Madrid, Spain; andres.castellanos@csic.es

In 1959, Prof. Richard Feynman gave his famous lecture "There's plenty of room at the bottom", which is considered the birth of the nanotechnology and nanoscience fields of research [1]. These disciplines are essentially new as mechanical, optical, magnetic, or electronic properties at the nanoscale strongly differ from their macroscopic counterparts, and new physical phenomena arise upon dimensionality reduction. But how can one work with matter at the nanoscale? During his lecture, he highlighted the importance of developing new techniques to interact with matter at the nanoscale: " ... What I want to talk about is the problem of manipulating and controlling things on a small scale ... ." In fact, the evolution of the nanoscience and nanotechnology fields has come hand-in-hand with the development of new experimental techniques that allowed us to interact with nanomaterials and nanoobjects in an unprecedented way. The archetypical example is the inventions of scanning tunneling and atomic force microscopes, which allowed us to "see", "touch" and "move" atoms with unmatched resolution for the first time [2,3]. Despite the importance of the development of new experimental techniques, tools and protocols in the advancement of this field of research, there is a lack of specialized forums to summarize, discuss and review these technical advances. In fact, many of these valuable research efforts have lost a great deal of visibility and might even have been overlooked because of being published in general instrumentation journals. These reasons motivated us to found *Nanomanufacturing* (ISSN 2673-687X), whose main goal is to provide an open forum for discussion and a platform to publish the latest results regarding the fabrication, manipulation, scalability and eventual industrial production of miniaturized devices or objects.

In spite of the long period since Feynman's famous lecture, the field of nanomanufacturing is still very active. Among the many outstanding works related to *Nanomanufacturing*, I would like to highlight a few that I believe set a research front in nanoscience and nanotechnology. First, it has been recently demonstrated that one can fabricate artificial materials by arranging atomically thin materials with exquisite control, showing a plethora of new physical phenomena, which opens a whole sub-field of research for future years [4]. Scientists have also brought one step closer to reality the fabrication of micro-/nanorobots that will allow us to perform complex tasks at very small scales [5]. The development of methodologies to improve the control on single-atom manipulation [6], the synthesis of nanomaterials or the combination of the synthesis of novel nanomaterials with self-assembly [7] are also very appealing research avenues in this field devoted to the control of things on a small scale. Lastly, I would like to highlight the continuous development of 3D printing technologies as well, also at the small scale, which promises to change the paradigm towards a society where objects are locally manufactured on demand [8].

Nanomanufacturing aims to publish works that are relevant to any field of study involving the fabrication of miniaturized devices or objects, their scalability, and their eventual industrial production. It focuses on all aspects of lithographic methods aimed at the submicron- to nano-scale; fabrication and integration of nanostructures, nanomaterials, and surfaces into functional devices; the exploitation and control of self-organization phenomena for patterning; and the further application of the created structures and devices in physical, biomedical, chemistry, environmental science and life science experiments.

Citation: Castellanos-Gomez, A. Nanomanufacturing: There's Still Plenty of Room at the Bottom. *Nanomanufacturing* **2021**, *1*, 1–2. https://doi.org/10.3390/nanomanufacturing1010001

Received: 4 February 2021
Accepted: 9 February 2021
Published: 23 February 2021

I thus genuinely believe that there's still plenty of room at the bottom, and I invite you all to join us to explore the limits of this room together. I hope that we can create around *Nanomanufacturing* a strong and active community of enthusiasts about micro- and nano-scale systems, techniques and tools. We are looking forward to receiving your works for publication in this journal!

Funding: This research received no external funding.

Conflicts of Interest: The author declares no conflict of interest.

References

1. Feynman, R.P. There's plenty of room at the bottom. *Eng. Sci.* **1960**, *23*, 22–36.
2. Binnig, G.; Rohrer, H.; Gerber, C.; Weibel, E. Surface Studies by Scanning Tunneling Microscopy. *Phys. Rev. Lett.* **1982**, *49*, 57–61. [CrossRef]
3. Binnig, G.; Quate, C.F.; Gerber, C. Atomic Force Microscope. *Phys. Rev. Lett.* **1986**, *56*, 930–933. [CrossRef] [PubMed]
4. Cao, Y.; Fatemi, V.; Fang, S.; Watanabe, K.; Taniguchi, T.; Kaxiras, E.; Jarillo-Herrero, P. Unconventional superconductivity in magic-angle graphene superlattices. *Nature* **2018**, *556*, 43–50. [CrossRef] [PubMed]
5. Wang, H.; Pumera, M. Fabrication of Micro/Nanoscale Motors. *Chem. Rev.* **2015**, *115*, 8704–8735. [CrossRef] [PubMed]
6. Kalff, F.E.; Rebergen, M.P.; Fahrenfort, E.; Girovsky, J.; Toskovic, R.; Lado, J.L.; Fernández-Rossier, J.; Otte, A.F. A kilobyte rewritable atomic memory. *Nat. Nanotechnol.* **2016**, *11*, 926–929. [CrossRef] [PubMed]
7. Avci, C.; Imaz, I.; Carné-Sánchez, A.; Pariente, J.A.; Tasios, N.; Pérez-Carvajal, J.; Alonso, M.I.; Blanco, A.; Dijkstra, M.; López, C.; et al. Self-assembly of polyhedral metal–organic framework particles into three-dimensional ordered superstructures. *Nat. Chem.* **2018**, *10*, 78–84. [CrossRef] [PubMed]
8. Regehly, M.; Garmshausen, Y.; Reuter, M.; König, N.F.; Israel, E.; Kelly, D.P.; Chou, C.-Y.; Koch, K.; Asfari, B.; Hecht, S. Xolography for linear volumetric 3D printing. *Nature* **2020**, *588*, 620–624. [CrossRef] [PubMed]

Short Biography of Author

Andres Castellanos-Gomez is a Tenured Scientist in the Spanish National Research Council (Consejo Superior de Investigaciones Científicas, CSIC). He explores novel 2D materials and studies their mechanical, electrical and optical properties with special interest in the application of these materials in nanomechanical and optoelectronic devices. He is the author of more than 150 articles in international peer-review journals and 6 book chapters. He is the principal investigator of a prestigious ERC Starting Grant. Among other recognitions, he has been appointed Fellow of the International Association of Advanced Materials (IAAM) in 2020, has been included in the Highly Cited Researchers 2018, 2019 and 2020 lists of Clarivate/WOS, and has also been recognized with the Young Researcher Award (experimental physics) of the Royal Physical Society of Spain (2016).