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Editorial

Special Issue: Characterizations of Three-Dimensional Surfaces at Micro/Nanoscale

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1. Introduction

Nowadays, understanding the structural properties of materials with a specific internal microstructure on all length scales is the key to discovering new products based on new technologies. Theoretical, technological, and applied problems related to the design of processes for the synthesis of new materials have arisen because each application requires the material to have a series of well-defined morpho-structural characteristics at the nanometric scale. Complex structure–property relationships as well as the recently developed strategies for relating desired properties to feasible structures and challenges for designing materials via the tailoring of hierarchical structures provide support for the decisions to be made during the design and development of materials.

2. Contributions

The papers included in this Special Issue cover discussions on all aspects of three-dimensional (3D) surface characterization techniques, ranging from descriptive statistics, stereometric analysis, power spectrum density analysis, fractal theory, and Hurst exponent distribution analysis. Additionally, there are some studies focusing on the theoretical simulation of micromorphology, computerized procedures, mathematical algorithms, and optimal research techniques to describe the 3D surface of materials at the micro/nanoscale.

The editors acknowledge all contributions, and we are delighted to introduce a collection of six high-quality research papers in this Special Issue.

Haub et al. [1] compared several platinum–carbon (PtC) nano-tips by focusing ion beam-induced deposition (FIBID) and focused electron beam-induced deposition (FEBID) using high-resolution transmission electron microscopy (HRTEM) analysis. They stated that there are significant differences in the nanostructure between the focused ion beam (FIB) and focused electron beam (FEB) nano-tips, something that is particularly evident in the FIB nano-tips: the higher the ion current, the greater the platinum content, the finer the grain size, and the higher the probability of a tunneling current approaching the nano-tips.

Ukkund et al. [2] reported the first-ever use of a halloysite nanotube (HNT), a relatively low-cost nanomaterial that is abundantly available and that has minor toxicity, for removing brilliant green dye from aqueous media. They studied the factors affecting adsorption by assessing thermodynamic properties such as adsorption capacity, kinetics, and equilibrium. The adsorbent features were interpreted using infrared spectroscopy and scanning electron microscopy. Additionally, the dye-modified HNT was observed to be a promising reinforcing material that could be used to fabricate composites using plastic waste.

Matos et al. [3] successfully map the morphology, wettability, and fractal behavior of the topographic spatial patterns of the Amazon Carapa guianensis Aubl. (Andiroba) leaf using scanning electron microscopy, atomic force microscopy, and fractal theory. This study also provided useful information about advanced ISO parameters related to the mi-

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crotexture of the leaf. The power spectrum density, fractal, and surface entropy parameters confirmed the strong fractal behavior of the plant leaf architecture.

Nagalingam et al. [4] assessed a modified measurement framework for the profile and areal surface texture characterization of as-built additive-manufactured (AM) components. The investigative framework was applied on surfaces built using four different AM techniques, whereas the surface asperities in an AM component were identified through scanning electron microscopy analyses. These authors suggest that this study helps to eliminate user speculations for selecting a particular measurement setting for roughness evaluation, improves confidence in selecting the appropriate measurement area for roughness evaluation, and improves awareness of the changes in the roughness results due to changes in the measurement settings.

Romaguera-Barcelay et al. [5] synthesized $GaMnO_3$, and thin films were deposited on $Pt(111)/TiO_2/SiO_2/Si$ substrates using a spin-coating apparatus to study the correlation between their stereometric and fractal parameters. The topographic maps of the thin films were obtained by atomic force microscopy. The authors stated that the deposition process of $GdMnO_3$ thin films and the subsequent sintering at 850 °C produces films with interesting topographic properties that can be used to improve the fabrication process of thin films based on systems involving rare earths, which are known as excellent multiferroic materials for technological applications.

Blachowicz et al. [6] evaluated atomic force microscopy (AFM) images of nanofiber mats using gray-scale-resolved Hurst exponent distributions based on random walks on monochromatic maps prepared according to the gray-scale distributions. The authors also proposed a new indicator of microscopic images, enabling the characterization of graphical information equivalent to different scales and sizes. These authors demonstrated that post-processing methods, such as the polynomial background subtraction, can support image evaluation according to the Hurst exponent distributions or reduce the information provided by the gray-scale-resolved Hurst exponent distributions such as a second sharpening step.

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References

1. Haub, M.; Günther, T.; Bogner, M.; Zimmermann, A. Investigation of Focused Ion and Electron Beam Platinum Carbon Nano-Tips with Transmission Electron Microscopy for Quantum Tunneling Vacuum Gap Applications. *Appl. Sci.* **2021**, *11*, 11793. [CrossRef]
2. Ukkund, S.J.; Puthiyillam, P.; Alshehri, H.M.; Goodarzi, M.; Taqui, S.N.; Anqi, A.E.; Safaei, M.R.; Ali, M.A.; Syed, U.T.; Mir, R.A.; et al. Adsorption Method for the Remediation of Brilliant Green Dye Using Halloysite Nanotube: Isotherm, Kinetic and Modeling Studies. *Appl. Sci.* **2021**, *11*, 8088. [CrossRef]
3. Matos, R.S.; Ţălu, Ş.; Mota, G.V.S.; Pinto, E.P.; Pires, M.A.; Abraçado, L.G.; Ferreira, N.S. Correlating Structure and Morphology of Andiroba Leaf (*Carapa guianensis* Aubl.) by Microscopy and Fractal Theory Analyses. *Appl. Sci.* **2021**, *11*, 5848. [CrossRef]
4. Nagalingam, A.P.; Vohra, M.S.; Kapur, P.; Yeo, S.H. Effect of Cut-Off, Evaluation Length, and Measurement Area in Profile and Areal Surface Texture Characterization of As-Built Metal Additive Manufactured Components. *Appl. Sci.* **2021**, *11*, 5089. [CrossRef]
5. Romaguera-Barcelay, Y.; Ţălu, Ş.; Matos, R.S.; Oliveira, R.M.P.B.; Moreira, J.A.; de Cruz, J.P.; da Fonseca Filho, H.D. Fractal-Stereometric Correlation of Nanoscale Spatial Patterns of $GdMnO_3$ Thin Films Deposited by Spin Coating. *Appl. Sci.* **2021**, *11*, 3886. [CrossRef]
6. Blachowicz, T.; Domino, K.; Koruszowic, M.; Grzybowski, J.; Böhm, T.; Ehrmann, A. Statistical Analysis of Nanofiber Mat AFM Images by Gray-Scale-Resolved Hurst Exponent Distributions. *Appl. Sci.* **2021**, *11*, 2436. [CrossRef]