Coatings are one of the forms of surface modifications of several parts produced in many branches of industry and daily life. Coatings may be applied for the protection of carbon steels, aluminum alloys, and even wood and concrete against environmental influence. The hard coatings decrease the wear resistance. However, even though painting is the most popular method of deposition of coatings on buildings, bridges, ships, etc., several functional coatings are being intensively developed. Such examples include the gas-barrier thin films protecting food [1], the coatings against excessive wear of different parts [2,3], textile coatings, e.g., by nanosilver [4], super-hydrophobic coatings [5], and ceramic–metal coatings for protection against erosion [6]. The coatings are often applied in medicine to make the healing time of load-bearing implants with bone faster, to enhance the antibacterial properties, to make steel implants bioinert and easy to remove, and many others. The examples are numerous [7–12].

This Special Issue is aimed at reviewing the newest achievements, particularly in biocoatings. They may be obtained through many techniques, such as direct electrocathodic deposition, pulse electrocathodic deposition, electrophoretic deposition, micro-arc oxidation, chemical and plasma vapor deposition, magnetron sputtering, pulsed laser deposition, electropolymerization, and the sol–gel method, further described in [13–22]. The biocoatings may be made of ceramics, polymeric, metals, or be composite coatings, all so far proposed in the literature.

The electrodeposition coating is among the most plausible techniques, because it makes it possible to design and obtain coatings with different microstructure, thickness, adhesion, and mechanical, physical, chemical, and biological properties. In this Special Issue, composed of nine papers, such examples are shown. One of them shows the deposition of metallic coatings, four papers consider oxidation processes of titanium alloy, three papers are devoted to composite coatings, and the last is review paper on the materials and methods.

Vainoris et al. [23] focused on metallic copper coatings deposited on a flat surface and 3D foams of Cu substrate. The copper deposition occurred much faster on copper foams than on a flat surface, making the metal foams highly suitable for electrowinning. The mechanism of copper deposition was determined, and the capacities of the double electric layer (DL) were calculated. In particular, the DL capacity was much higher and the charge transfer resistance slightly lower for the Cu foam electrodes. As a consequence of this research, the metal foam electrodes were recommended for use in several electrochemical processes.

Ossowska and Zielinski [24] investigated the behavior of new and already used dental implants and the role of oxide layers. In particular, the possible mechanisms of oxide degradation and its influence on titanium corrosion at inflammation states were considered. The extremely low dissolution of rutile, slightly increasing along with pH, was measured. The diffusion of titanium ions through the oxide layer was shown as negligible. The single important mechanism of corrosion was demonstrated as initiated by the oxide layer
damage at the defects caused by either the manufacturing process or implantation surgery. Therefore, a stepwise appearance and development of cracks through the oxide layers could be observed and enhance titanium corrosion.

Ossowska et al. [25] focused on the development of sandwich oxide coatings on a titanium base. Two-stage oxidation resulted in the inner solid layer and the outer nanotubular layer of oxides. Such structure of the coating significantly improved mechanical (hardness) and chemical (corrosion resistance) properties. This new technique may be used to substantially improve the surface of titanium load-bearing implants.

Jazdzewska and Bartmanski [26] aimed at increasing the corrosion resistance and improving the biocompatibility by oxidation of a model screw dental implant made of the Ti–13Nb–13Zr alloy. The obtained nanotubular layers were of thickness 30–80 nm. The important difference in roughness was noticed between the top of the helix and its bottom. Uneven oxidation of screw model implants resulted in higher corrosion current and less noble corrosion, also known as pitting.

Dziaduszewska et al. [27] studied the micro-arc oxidation in some Ca- and P-containing electrolytes of the selective laser-melted Ti–13Nb–13Zr alloy to obtain ceramic–ceramic composite coatings. The study showed the voltage as the most significant process parameter influencing the coating characteristic. They obtained the coatings with a high Ca:P ratio, hydrophilicity, early-stage bioactivity, Young’s modulus, and hardness close to those of bone, and appropriate adhesion of the coating to the titanium surface preventing delamination. Such coatings are especially suitable for dental implants.

Majkowska et al. [28] investigated deposition by the electrophoretic method of ceramic–ceramic coatings composed of hydroxyapatite and carbon nanotubes achieved as bilayers (subsequent deposition) and hybrid coatings (simultaneous deposition). It was shown that the pure multi-wall carbon nanotubes (CNTs) layer showed the best mechanical and biological properties. Both bilayers and hybrid coatings demonstrated insufficient properties attributed to the presence of soft, porous hydroxyapatite and the agglomeration of CNTs.

Pawlowski et al. [29] studied the ceramic–polymer coatings obtained by electrophoretic deposition and composed of chitosan and Eudragit compounds. The best process parameters were estimated. The Young’s modulus of coatings was close to that of human cortical bone. The doping of Eudragit significantly reduced the degradation of coatings in artificial saliva at neutral pH, while maintaining high sensitivity to pH changes. The composite coatings showed a slightly lower corrosion resistance compared to the chitosan coating, and comparable hydrophilicity.

Zhang et al. [30] studied metallic (Fe)–ceramic coatings obtained by micro-arc oxidation on Mg alloys. The deposition of such coatings substantially increased the degradation resistance and in vitro cytocompatibility. The developed coatings exhibited potential in clinical applications.

In their paper, Zielinski and Bartmanski [31] reviewed the state of the art in electrodeposition coatings. The developments of metallic, ceramic, polymer, and composite electrodeposited coatings were investigated. The direct cathodic electrodeposition, pulse cathodic deposition, electrophoretic deposition, micro-arc oxidation in electrolytes rich in P and Ca ions, electro-spark, and electro-discharge methods were characterized. The most popular were the direct and pulse cathodic electrodeposition, and electrophoretic deposition. The justification of the development of different coatings was an expected increase in bioactivity, mechanical strength, adhesion of coatings, and antibacterial properties.

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

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