(power industry, construction), as well as difficulties associated with high investment and operational costs (energy-intensive process), highly skilled staff needs to be employed, a position of buyers and suppliers in the delivery chain is strong, and the level of specialisation is high and applicability is true for a narrow range of products. If the safeguard system is used improperly or fails, a radiation hazard may occur, which is a disadvantage considering the environmental friendliness of the process. Energy-intensive electron-beam irradiation is used primarily for modifying deeper layers of the material up to 40 mm thick such as usually the insulating sheaths of power cables or polyethylene tubes and plates or structural materials containing different polymers. The purpose of modification causing the netting of the surface layer of the material is to improve mechanical strength, resistance to degradation processes and improved hydrophilicity next allowing to glue, print and/or decorate it. The predicted development of the technology (E) will be aimed at improving the modification devices and optimising the process parameters, and a surprise development scenario for the technology, both an optimistic and pessimistic one, is not out of question.

References

1. http://ec.europa.eu/europe2020/priorities/sustainable-growth/ index_pl.html.
2. http://ec.europa.eu/research/innovation-union/index_en.cfm?pg=home.
3. http://manufacturing-visions.org/download/Final_Report_final.pdf.
4. H. Dosch, M.H. Van de Voorde (eds.), Gennesys, White Paper, A New European Partnership between Nanomaterials Science & Nanotechnology and Synchrotron Radiation and Neuron Facilities, Max-Planck-Insititut für Metalforschung, Stuttgart, 2009.
5. The Future of Manufacturing in Europe 2015-2020, The Challenge for Sustainability, Materials, Final Report. Groupe CM International; 2003, http://ec.europa.eu/research/industrial_technologies /pdf/pro-futman-doc3a.pdf.
6. M. Montorio, M. Taisch, K.D. Thoben (eds.), Advanced Manufacturing. An ICT and Systems Perspective, Taylor & Francis Group, London, 2007.
7. NanoMat, www.nanomat.eitplus.pl (in Polish).
8. ForeMat, www.foremat.org (in Polish).
9. Advanced Industrial and Ecological Technologies for Sustainable Development of Poland, www.portaltechnologii. pl/3index/index.html.
10. FORSURF, www.forsurf.pl (in Polish).

11. L.A. Dobrzański, M. Drak, Structure and properties of composite materials with polymer reinforced Nd-Fe-B hard magnetic materials, Journal of Materials Processing Technology 157-158 (2004) 650-657.
12. S. Żółkiewski, Testing composite materials connected in bolt joints, Journal of Vibroengineering 13/4 (2011) 817-822.
13. L.A. Dobrzański, M. Drak, J. Trzaska, Corrosion resistance of the polymer matrix hard magnetic composite materials Nd-Fe-B, Journal of Materials Processing Technology 164-165 (2005) 795-804.
14. L.A. Dobrzański, R. Nowosielski, A. Przybył, J. Konieczny, Soft magnetic nanocomposite with powdered metallic ribbon based on cobalt and polymer matrix, Journal of Materials Processing Technology 162-163 (2005) 20-26.
15. H. Horn, S. Beil, D.A. Wesner, R. Weichenhain, E.W. Kreutz, Excimer laser pretreatment and metallization of polymers, Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms 151 (1999) 279-284.
16. L.M. Galantucci, A. Gravina, G. Chita, M. Cinquepalmi, Surface treatment for adhesive-bonded joints by excimer laser, Composites Part A 27 (1996) 1041-1049.
17. L.A. Dobrzański, Fundamentals of materials science and physical metallurgy. Engineering materials with the fundamentals of materials design, WNT, Warsaw, 2002 (in Polish).
18. L.A. Dobrzański, Metal engineering materials, WNT, Warsaw, 2004 (in Polish).
19. M. Ozdemir, H. Sadikoglu, A new and emerging technology: Laser-induced surface modification of polymers, Trends in Food Science & Technology 9 (1998) 159-167.
20. J. Lawrence, L. Li, Modification of the wettability characteristics of polymethyl methacrylate (PMMA) by means of CO_2, Nd:YAG, excimer and high power diode laser radiation, Materials Science and Engineering A 303 (2001) 142-149.
21. K. Callewaert, Y. Martelé, L. Breban, K. Naessens, P. Vandaele, R. Baets, G. Geuskens, E. Schacht, Excimer laser induced patterning of polymeric surfaces, Applied Surface Science 208-209 (2003) 218-225.
22. P. Rytlewski, M. Żenkiewicz, Polymer materials laser modification. II Reaction induced by laser light, Polymers 52 (2007) 403-410 (in Polish).
23. A.D. Dobrzańska-Danikiewicz, Computer Aided Foresight Integrated Research Methodology in Surface Engineering Area, work in progress.
24. A.D. Dobrzańska-Danikiewicz, Foresight methods for technology validation, roadmapping and development in the surface engineering area, Archives of Materials Science and Engineering 44/2 (2010) 69-86.
25. A.D. Dobrzańska-Danikiewicz, E-foresight of materials surface engineering, Archives of Materials Science and Engineering 44/1 (2010) 43-50.
26. A.D. Dobrzańska-Danikiewicz, J. Trzaska, A. Jagiełło, E. Jonda, K. Labisz, Neural networks aided future events scenarios presented on the example of laser surface treatment, Archives of Materials Science and Engineering 51/2 (2011) 69-96.

27. Pt. USA, 3.018.189, 1962.
28. Pat. USA, 3.113.208, 1963.
29. Pat. USA, 3.640.733, 1962.
30. M. Żenkiewicz, S. Lutomirski, J. Gołębiewski, Activator for polyolefin pipes, Chemical Engineering and Apparatus 5 (1999) 20-22 (in Polish).
31. A.P. Napartovich, Overview of atmospheric pressure discharges producing nonthermal plasma, Plasma and Polymers 6 (2001) 1-14.
32. M. Żenkiewicz, P. Rytlewski, R, Malinowski, Compositional, physical and chemical modification of polylactide, Journal of Achievements in Materials and Manufacturing Engineering 43/1 (2010) 192-199.
33. A. Belevtsev, L.M. Biberman, On the theory of corona discharge, Beiträge zur Plasmaphysik 23 (1983) 313-329.
34. M. Żenkiewicz, J. Richert, P. Rytlewski, K. Moraczewski, Some effects of corona plasma treatment of polylactide/ montmorillonite nanocomposite films, Plasma Processes and Polymers 6 (2009) S387-S391.
35. H. Stryczewska, Plasma technologies in power and environmental engineering, Lublin University of Technology Publishing House, Lublin, 2009 (in Polish).
36. Z. Celiński, Plasma, PWN, Warsaw, 1980 (in Polish).
37. W.N. Orajewski, Plasma on Earth and in space, PWN, Warsaw, 1989 (in Polish).
38. A. Kordus, Plasma. Properties and applications in engineering, WNT, Warsaw, 1985 (in Polish).
39. J. Musielok, About the determination of atomic constants on the basis of low temperature plasma radiation analysis, Physics Progress 53 (2002) 132-136 (in Polish).
40. Y.S. Akishev, M.E. Grushin, A.E. Monich, A.P. Napartovich, N.I. Trushkin, One - atmosphere argon dielectric-barrier corona discharge as an effective source of cold plasma for the treatment of polymer films and fabrics, High Energy Chemistry 37 (2003) 286-291.
41. P. Slepička, A. Vasina, Z. Kolská, T. Luxbacher, P. Malinsky, A. Macková, V. Švorčík, Argon plasma irradiation of polypropylene, Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms 268 (2010) 2111-2114.
42. M. Żenkiewicz, Adhesion and surface layer modification of multiparticles materials, WNT, Warsaw, 2000 (in Polish).
43. M. Żenkiewicz, J. Gołębiewski, Characteristics of the modification process of multiparticles materials using low temperature plasma, Polymers 43 (1998) 351-358 (in Polish).
44. L. Bárdos, H. Baránková, Cold atmospheric plasma: Sources, processes, and applications, Thin Solid Films 518 (2010) 6705-6713.
45. J. Yip, K. Chan, K.M. Sin, K.S. Lau, Formation of periodic structures by surface treatments of polyamide fiber: Part I. UV excimer laser irradiation, Applied Surface Science 253 (2006) 2637-2643.

46. T. Lippert, T. Nakamura, H. Niino, A. Yabe, Laser induced chemical and physical modifications of polymer films: dependence on the irradiation wavelength, Applied Surface Science 109-110 (1997) 227-231.
47. D. Bäuerle, R. Denk, J.D. Pedarning, K. Piglmayer, J. Heitz, G. Schrems, Perspectives of laser processing and chemistry, Applied Physics A 77 (2003) 203-207.
48. A.C. Duncan, F. Rouais, S. Lazare, L. Bordenave, Ch. Baquey, Effect of laser modified surface microtopochemistry on endothelial cell growth, Colloids and Surfaces B: Biointerfaces 54 (2007) 150-159.
49. C. Wochnowski, M.A. Shams Eldin, S. Metev, UV-laser-assisted degradation of poly(methyl methacrylate), Polymer Degradation and Stability 89 (2005) 252-264.
50. J. Blazevska-Gilev, J. Kupcık, J. Subrt, Z. Bastl, V. Vorlıcek, A. Galıkova, D. Spaseska, IR laser ablation of poly(vinyl chloride): Formation of monomer and deposition of nanofibres of chlorinated polyhydrocarbon, Polymer Degradation and Stability 91 (2006) 213-220.
51. P. Rytlewski, M. Żenkiewicz, Laser modification of polymer materials. I. Physical fundamentals of laser activity and selection, Polymers 52 (2007) 241-250 (in Polish).
52. P. Rytlewski, M. Żenkiewicz, Laser modification of polymer materials. III. Laser ablation and surface geometric structure changes, polymers change the geometric structure of the surface, Polymers 52 (2007) 634-639 (in Polish).
53. P. Rytlewski, M. Żenkiewicz, Laser induced surface modification of polystyrene, Applied Surface Science 256 (2009) 857-861.
54. P. Rytlewski, M. Żenkiewicz, Effects of laser irradiation on surface properties of poly(ethylene terephthalate), Journal of Adhesion Science and Technology 24 (2010) 685-697.
55. F. Hanus, K. Kolev, A. Jadin, L.A. Laude, Excimer laser – induced copper nanocluster formation in mixed PMMA/copper acetyloacetonate films, Applied Surface Science 154-155 (2000) 320-323.
56. P. Rytlewski, Laser induced electroactivity of polyamide composites, Electrochimica Acta 61 (2011) 191-197.
57. R.L Clough, High-energy radiation and polymers: A review of commercial processes and emerging applications, Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms 185 (2001) 8-33.
58. P. Rytlewski, M. Żenkiewicz, R. Malinowski, Influence of the dicumyl peroxide content on thermal and mechanical properties of polylactide, International Polymer Processing 26 (2011) 580-586.
59. P. Rytlewski, R. Malinowski, K. Moraczewski, M. Żenkiewicz, Influence of some crosslinking agents on thermal and mechanical properties of electron beam irradiated polylactide, Radiation Physics and Chemistry 79 (2010) 1052-1057.
60. M. Żenkiewicz, R. Malinowski, P. Rytlewski, A. Richert, W. Sikorska, K. Krasowska, Some composting and biodegradation effects on physically or chemically crosslinked poly(lactic acid), Polymer Testing 31 (2012) 83-92.

61. S.K. Koh, S. Park, S. Kim, W. Choi, H. Jung, K. Pae, Surface modification of polytetrafluoroethylene by Ar+ irradiation for improved adhesion to other materials, Journal of Applied Polymer Science 64/10 (1997) 1913-1921.
62. M. Żenkiewicz, P. Rytlewski, J. Czupryńska, J. Polański, T. Karasiewicz, W. Engelgard, Contact angle and surface free energy of electron-beam irradiated polymer composites, Polymers 53 (2008) 446-451.
63. N. Gerdsri, R.S. Vatananan, S. Dansamasatid, Dealing with the dynamics of technology road-mapping implementation: A case study, Technical Forecasting & Social Change 76 (2009) 50-60.
64. Y. Yasunaga, M. Watanabe, M. Korenaga, Application of technology roadmaps to governmental innovation Policy for promoting technology convergence, Technical Forecasting & Social Change 76 (2009) 61-79.
65. R. Phaal, G. Muller, An architectual framework for roadmapping: Towards visual strategy, Technological Forecasting & Social Change 76 (2009) 39-49.
66. A.D. Dobrzańska-Danikiewicz, T. Tański, S. Malara, J. Domagała-Dubiel, Assessment of strategic development perspectives of laser treatment of casting magnesium alloys, Archives of Materials Science and Engineering 45/1 (2010) 5-39.
67. A.D. Dobrzańska-Danikiewicz, K. Lukaszkowicz, Technology strategic development directions of PVD coatings deposition onto the brass substrate, Materials Science Engineering 4 (2011) 558-561 (in Polish).
68. A.D. Dobrzańska-Danikiewicz, E. Jonda, K. Labisz, Foresight methods application for evaluating laser treatment of hot-work steels, Journal of Achievements in Materials and Manufacturing Engineering 43/2 (2010) 750-773.
69. A.D. Dobrzańska-Danikiewicz, E. Hajduczek, M. Polok-Rubiniec, M. Przybył, K. Adamaszek, Evaluation of selected steel thermochemical treatment technology using foresight methods, Journal of Achievements in Materials and Manufacturing Engineering 46/2 (2011) 115-146.
70. A.D. Dobrzańska-Danikiewicz, K. Gołombek, D. Pakuła, J. Mikuła, M. Staszuk, L.W. Żukowska, Long-term development directions of PVD/CVD coatings deposited onto sintered tool materials, Archives of Materials Science and Engineering 49/2 (2011) 69-96.
71. A.D. Dobrzańska-Danikiewicz, A. Drygała Strategic development perspectives of laser processing on polycrystalline silicon surface, Archives of Materials Science and Engineering 50/1 (2011) 5-20.
72. A.D. Dobrzańska-Danikiewicz, A. Kloc-Ptaszna, B. Dołżańska, Manufacturing technologies of sintered graded tool materials evaluated according to foresight methodology, Archives of Materials Science and Engineering 50/2 (2011) 69-96.