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Progresses on Green and Smart Materials for Multifaceted Applications

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Abstract

Sustainable development is widely known as a critical issue for the future growth and well-being of our society. Technological advancement has provided smart material development opportunities for multifunctional applications in energy, construction, infrastructure, electronics, and building. Green materials are proficient, safe, economically viable, and reliable because of their eco-friendliness and renewable prowess. This chapter looks into the progress of natural and resource-efficient materials for smart manufacturing processes that could be used for intelligent application and address contemporary materials' challenges.

Keywords

- **Sustainable development**

- **Smart materials**
- **Technological advancement**
- **Manufacturing processes**
- **Material development**

References

- Abi-Akar R, Jones G, Tang Y (2017) Opportunities for sustainable materials management and zero waste in detroit

Google Scholar

- Adams R, Jeanrenaud S, Bessant J, Denyer D, Overy P (2016) Sustainability-oriented innovation: a systematic review. Int J Manag Rev 18:180–205

CrossRef Google Scholar

- Addington DM, Schodek DL (2005) Smart materials and new technologies: for the architecture and design professions. Routledge

Google Scholar

- Addington M, Schodek D (2012) Smart materials and technologies in architecture. Routledge

CrossRef Google Scholar

- Ahmed K, Shiblee MNI, Khosla A, Nagahara L, Thundat T, Furukawa H (2020) Recent progresses in 4D printing of gel materials. J Electrochem Soc 167(3):037563

CrossRef Google Scholar

- Akhras G (2000) Smart materials and smart systems for the future. Can Military J 1(3):25–31

Google Scholar

- Alzahrani A, Petri I, Rezgui Y, Ghoroghi A (2020) Developing smart energy communities around fishery ports: toward zero-carbon fishery ports. Energies 13(11):2779

CrossRef Google Scholar

- Applications of Smart Materials. Date Accessed October, 21, 2020

Google Scholar

- Ashima R, Haleem A, Bahl S, Javaid M, Mahla SK, Singh S (2021) Automation and manufacturing of smart materials in additive manufacturing technologies using internet of things towards the adoption of industry 4.0. Mater Today: Proc 45:5081–5088

Google Scholar

- Bajpai A, Baigent A, Raghav S, Brádaigh CÓ, Koutsos V, Radacsi N (2020) 4D printing: materials, technologies, and future applications in the biomedical field. Sustainability 12(24):10628

CrossRef Google Scholar

- Basheer AA (2020) Advances in the smart materials applications in the aerospace industries. Aircr Eng Aerosp Technol 92(7):1027–1035

CrossRef Google Scholar

- Batra AK, Alomari A (2017) Power harvesting via smart materials. SPIE Press, pp 1–15

CrossRef **Google Scholar**

- Bhardwaj AK, Garg A, Ram S, Gajpal Y, Zheng C (2020) Research trends in green product for environment: a bibliometric perspective. Int J Environ Res Public Health 17(8469):1–21

Google Scholar

- Boström M, Andersson E, Berg M, Gustafsson K, Gustavsson E, Hysing E et al (2018) Conditions for transformative learning for sustainable development: a theoretical review and approach. Sustainability 10(12):4479

CrossRef **Google Scholar**

- Bourtsalas A (2019) In: Themelis NJ (ed) Recovery of materials and energy from urban wastes: a volume in the encyclopedia of sustainability science and technology. Springer, New York

Google Scholar

- Cruz DM, Mostafavi E, Vernet-Crua A, Barabadi H, Shah V, Cholula-Díaz JL et al (2020) Green nanotechnology-based zinc oxide (ZnO) nanomaterials for biomedical applications: a review. J Phys: Mater 3(3):034005

Google Scholar

- Čukušić M, Jadrić M, Mijač T (2019) Identifying challenges and priorities for developing smart city initiatives and applications. Croat Oper Res Rev 10(1):117–129

CrossRef **Google Scholar**

- Cunha AG, Gandini A (2010) Turning polysaccharides into hydrophobic materials: a critical review. Part 1. Cellulose. Cellulose 17(5):875–889

CrossRef **Google Scholar**

- Dangelico RM (2016) Green product innovation: where we are and where we are going. Bus Strategy Environ 25:560–576

CrossRef **Google Scholar**

- Di Rito G, Chiarelli MR, Luciano B (2020) Dynamic modelling and experimental characterization of a self-powered structural health-monitoring system with M.F.C. piezoelectric patches. Sensors 20(4):950

CrossRef **Google Scholar**

- Dineva P, Gross D, Müller R, Rangelov T (2014) Piezoelectric materials. In: Dynamic fracture of piezoelectric materials (pp. 7–32). Springer, Cham

Google Scholar

- Elias MJ (2009) Food in the United States, 1890–1945. ABC-CLIO

Google Scholar

- Esther L, Piselli A, Faucheu J, Delafosse D, Del Curto B (2014) Smart materials: development of new sensory experiences through stimuli responsive materials. In: 5th S.T.S. Italia conference a matter of design: making society through science and technology (pp 367–382). S.T.S. Italia

Google Scholar

- Fairman R, Åkerfeldt KS (2005) Peptides as novel smart materials. Curr Opin Struct Biol 15(4):453–463

CrossRef **Google Scholar**

- Farag SG (2019) Application of smart structural systems for smart sustainable cities. In: 2019 4th M.E.C. International Conference on Big Data and Smart City (ICBDSC) (pp 1–5)

Google Scholar

- Fraser AG, Butchart EG, Szymański P, Caiani EG, Crosby S, Kearney P, Van de Werf F (2018) The need for transparency of clinical evidence for medical devices in Europe. Lancet 392(10146):521–530

CrossRef **Google Scholar**

- Gandhi MV, Thompson BD (1992) Smart materials and structures. Springer Science & Business Media

Google Scholar

- Goldan T, Nistor MC (2019) Reducing self-heating coal stockpile for prevention of environmental hazard. Int Multidiscip Sci GeoConference: SGEM 19(1.3):513–519

Google Scholar

- Haleem A, Javaid M, Singh RP, Suman R (2021) Significant roles of 4D printing using smart materials in the field of manufacturing. Adv Ind Eng Polymer Res

Google Scholar

- Haruna VN, Abdulrahman AS, Zubairu PT, Isezuo LO, Abdulrahman MA, Onuoha DC (2014) Prospects and challenges of composites in a developing country. ARPN J Eng Appl Sci 9(7):1069–1075

Google Scholar

- Hu CY, Yoon TR (2018) Recent updates for biomaterials used in total hip arthroplasty. Biomaterials Res 22(1):1–12

CrossRef **Google Scholar**

- Karslioğlu A, Balaban E, Onur Mİ (2021) Insulation properties of bricks with waste rubber and plastic: a review. J Nat 1:20–27

Google Scholar

- Kochovski P, Stankovski V (2018) Supporting smart construction with dependable edge computing infrastructures and applications. Autom Constr 85:182–192

CrossRef **Google Scholar**

- Konarzewska B (2017a) Smart materials in architecture: useful tools with practical applications or fascinating inventions for experimental design. In: I.O.P. Conf series: materials science and engineering, 245, 052098

Google Scholar

- Konarzewska B (2017b) Smart materials in architecture: useful tools with practical applications or fascinating inventions for experimental design. In: I.O.P. Conf series: materials science and engineering (Vol. 245, p. 052098)

Google Scholar

- Krishna JG, Thirumal JR (2015) Application of smart materials in smart structures. Int J Innov Res Sci Eng Technol 4(7)

Google Scholar

- Kuhlman T, Farrington J (2010) What is sustainability? Sustainability 2(11):3436–3448

CrossRef **Google Scholar**

- Li VC (2019) High-performance and multifunctional cement-based composite material. Engineering 5:250–260

CrossRef **Google Scholar**

- Li X, Su X (2018) Multifunctional smart hydrogels: potential in tissue engineering and cancer therapy. J Mater Chem B 6(29):4714–4730

CrossRef **Google Scholar**

- Li X, Shang J, Wang Z (2017) Intelligent materials: a review of applications in 4D printing. Assem Autom

Google Scholar

- Mahmoudian M, Sharifikheirabadi P (2019) Uses of new/smart materials in the green building with sustainability concerns. Int Trans J Eng Manag Appl Sci Technol:1–9

Google Scholar

- Mattern F, Staake T, Weiss M (2010) I.C.T. for green: how computers can help us to conserve energy. In: Proceedings of the 1st international conference on energy-efficient computing and networking (pp 1–10)

Google Scholar

- Mayeen A, Kalarikkal N (2018) Development of ceramic-controlled piezoelectric devices for biomedical. Fundamental Biomaterials: Ceram 47

Google Scholar

- Mensah J, Casadevall SR (2019) Sustainable development: meaning, history, principles, pillars, and implications for human action: literature review. Cogent Soc Sci 5(1):1653531

Google Scholar

- Mohamed ASY (2017) Smart materials innovative technologies in architecture; towards innovative design paradigm. Energy Procedia 115:139–154

CrossRef Google Scholar

- Momeni F (2018) 4D Printing as a new paradigm for advanced manufacturing (Doctoral dissertation)

Google Scholar

- Mostafaei A, Elliott AM, Barnes JE, Li F, Tan W, Cramer CL et al (2021) Binder jet 3D printing—process parameters, materials, properties, modeling, and challenges. Prog Mater Sci 119:100707

CrossRef Google Scholar

- Müller P, Schmid M (2019) Intelligent packaging in the food sector: a brief overview. Foods 8(1):16

CrossRef Google Scholar

- Nguyen PQ, Courchesne NMD, Duraj-Thatte A, Praveschotinunt P, Joshi NS (2018) Engineered living materials: prospects and challenges for using biological systems to direct the assembly of smart materials. Adv Mater 30(19):1704847

CrossRef **Google Scholar**

- Oliveira J, Correia V, Castro H, Martins P, Lanceros-Mendez S (2018) Polymer-based smart materials by printing technologies: improving application and integration. Addit Manuf 21:269–283

Google Scholar

- Pereira Á, Vence X (2012) Key business factors for eco-innovation: an overview of recent firm-level empirical studies. Cuad Gest 12:73–103

CrossRef **Google Scholar**

- Rayna T, Striukova L (2021) Assessing the effect of 3D printing technologies on entrepreneurship: an exploratory study. Technol Forecast Soc Chang 164:120483

CrossRef **Google Scholar**

- Rosace G, Guido E, Colleoni C, Brucale M, Piperopoulos E, Milone C, Plutino MR (2017) Halochromic resorufin-GPTMS hybrid sol-gel: chemical-physical properties and use as pH sensor fabric coating. Sensors Actuators B Chem 241:85–95

CrossRef **Google Scholar**

- Roy S, Mishra H, Mohapatro BG (2016) Creating sustainable environment using smart materials in smart structures. Indian J Sci Technol 9(30)

Google Scholar

- Rudrapati R (2020) Graphene: fabrication methods, properties, and applications in modern industries. In: Graphene production and application. IntechOpen, Rijeka, pp 9–22

Google Scholar

- Safiuddin M, Jumaat MZ, Salam MA, Islam MS, Hashim R (2010) Utilization of solid wastes in construction materials. Int J Phys Sci 5(13):1952–1963

Google Scholar

- Salvarli MS, Salvarli H (2020) For sustainable development: future trends in renewable energy and enabling technologies. In: Renewable energy-resources, challenges and applications. IntechOpen

Google Scholar

- Sima V, Gheorghe IG, Subić J, Nancu D (2020) Influences of the industry 4.0 revolution on the human capital development and consumer behavior: a systematic review. Sustainability 12(10):4035

CrossRef Google Scholar

- Stępień GJ (2020) Internet of things (I.O.T.): smart kitchen appliences for the U.S. market (Doctoral dissertation)

Google Scholar

- Tariq A, Badir YF, Tariq W, Bhutta US (2017) Drivers and consequences of green product and process innovation: a systematic review, conceptual framework, and future outlook. Technol Soc 51:8–23

CrossRef Google Scholar

- The World Bank (2018) What a waste: an updated look into the future of solid waste management. World Bank

Google Scholar

- Wiklund J, Karakoç A, Palko T, Yiğitler H, Ruttik K, Jäntti R, Paltakari J (2021) A review on printed electronics: fabrication methods, inks, substrates, applications and environmental impacts. J Manuf Mater Process 5(3):89

Google Scholar

- Wood J (2008) The top ten advances in materials science. Mater Today 11(1–2):40–45

CrossRef Google Scholar

- Yüksek I, Karadayi TT (2017) Energy-efficient building design in the context of building life cycle. Energy Efficient Build:93–123

Google Scholar

- Zakirullin R, Odenbakh I (2020) Chromogenic materials in optical filters for smart windows. In: Novel optical materials and applications (pp JTu4C-19). Optical Society of America

Google Scholar

- Zhang Y, Beggs PJ, McGushin A, Bambrick H, Trueck S, Hanigan IC et al (2020) The 2020 special report of the M.J.A.–lancet countdown on health and climate change: lessons learnt from Australia's "black summer". Med J Aust 213(11):490–492

CrossRef Google Scholar

- Zhu FB, Zhang CL, Qian J, Chen WQ (2016) Mechanics of dielectric elastomers: materials, structures, and devices. J Zhejiang Univ-Sci A 17(1):1–21

Google Scholar

- Zverev VI, Pyatakov AP, Shtil AA, Tishin AM (2018) Novel applications of magnetic materials and technologies for medicine. J Magn Magn Mater 459:182–186

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