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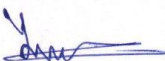
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# HANDBOOK OF NANOMATERIALS FOR WASTEWATER TREATMENT

Fundamentals and Scale up Issues

Edited by

Bharat A. Bhanvase

Shirish H. Sonawane

Vijay B. Pawade

Aniruddha B. Pandit



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2020-21

## CHAPTER 7

## New graphene-based nanocomposite for photocatalysis

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<sup>b</sup>Department of Chemistry, MGSM's Arts, Science and Commerce College, Chopda, Maharashtra, India,

<sup>c</sup>Department of Chemical Engineering, National Institute of Technology, Warangal, Telangana, India

### 7.1 Introduction

Graphene (G) and its derivatives are finding use for various applications and have arisen as a high-flier on the prospect of materials science [1–10]. The first well-known example of G was introduced by British chemist Benjamin Collins Brodie in 1859. He prepared G by treating G flakes in an oxidative environment [11]. However, in 2004, Andre Geim and Kostya Novoselov of the University of Manchester won the Nobel Prize for their discovery of G [12]. G is a thin, two-dimensional (2D), polyaromatic,  $sp^2$  carbon hexagonal network that is the lightest, strongest, most electrically and thermally conductive material, which has found many applications to captivate the attention of the scientific community [13]. Since the last decade, G has gained huge interest, steady progress in commercialization, and is widely used by different scientific communities for various applications. To date, the production of G increased from 14 tons to nearly 1200 tons [14]. The long-range, 2D  $sp^2$  carbon hexagonal network system in G offers extraordinary physical properties, extremely large specific surface area ( $2630 \text{ m}^2 \text{ g}^{-1}$ ), high elasticity, thermal and electricity conductivity, captivating electronic properties, and most importantly charge carrier's behavior as massless relativistic particles [15]. Due to an exceptional mechanical property, G succeeds as an outstanding material for various potential applications such as solar cells, sensors, hydrogen generation via water-splitting, energy storage devices, and catalytic activities [16]. G is a zero-gap 2D semimetal with tiny overlap between valence band (VB) and conduction band (CB) plus high surface area, which makes it an appropriate nanoadsorbent and nanocatalyst [15, 17]. Despite the excellent features of pristine G sheets, low dispersion in water, agglomeration in solution due to Van der Waals interactions, and difficult bottom-up synthesis limits their





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## CHAPTER 18

# Carbon-based nanocomposite membranes for water purification

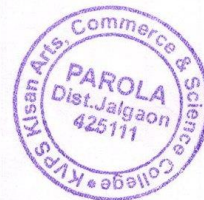
Swapnil L. Sonawane<sup>a</sup>, Prakash K. Labhane<sup>b</sup>, and Gunvant H. Sonawane<sup>c</sup>

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### 18.1 Introduction to nanomaterials

Clean and safe water plays a vital role in human health and the ecosystem; however, the 785 million people around the world are having difficulties accessing basic drinking water service, as reported by the World Health Organization (WHO) (<https://www.who.int/news-room/fact-sheets/detail/drinking-water>). Though natural water sources are available, the scarcity and poor water quality is an issue in many parts of the world. The sudden increase in population and industrial growth is responsible for the world's water pollution. Basically, there are different types of impurities present in water, which include hybrid pollutants (organic-inorganic) and microorganisms [1, 2]. Since contaminated water introduces harmful disease that can cause illness or even death, it is an alarming concern worldwide. Therefore new development in advanced technology for water purification (treatment of wastewater/desalination/recycle/reuse/recovery) is in high demand [3, 4]. This would help to overcome the 21st century challenge for obtaining fresh and safe water (for beneficial use) and to save the natural resources of water on the earth.

A suitable material with high durability, inexpensive, high porosity, high separation capacity, and reusability are the basic requirements for obtaining fresh/safe water [5, 6]. With respect to this, nanotechnology offers an excellent platform where an advanced nanomaterial having required properties (flexibility, high mechanical/thermal strength, stability, high adsorption capacity, etc.) can be developed [7, 8]. Nanomaterials (nanoparticles such as metal oxide, graphene, CNTs, TiO<sub>2</sub>, zeolites, etc.) in the form of various shapes/size (1–100 nm) and morphology are available for sustainable development (Fig. 18.1). With applications in the fields of medicine, antibacterial properties, redox and photocatalytic properties, energy storage, adsorption, sensing/detection of pollutant, filler in membrane, etc., nanomaterials can also address environmental problems such as purification of water and wastewater treatment [9–11].





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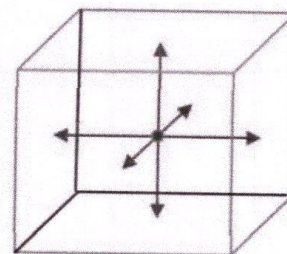
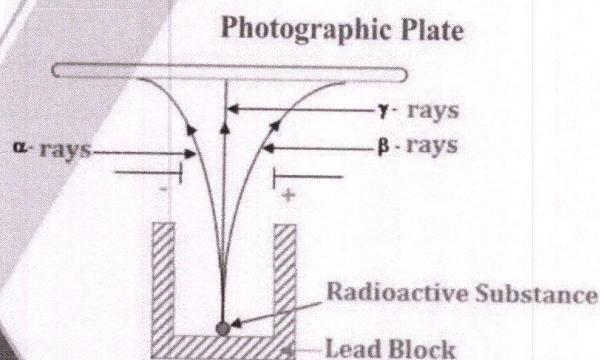
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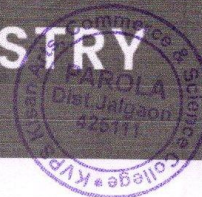
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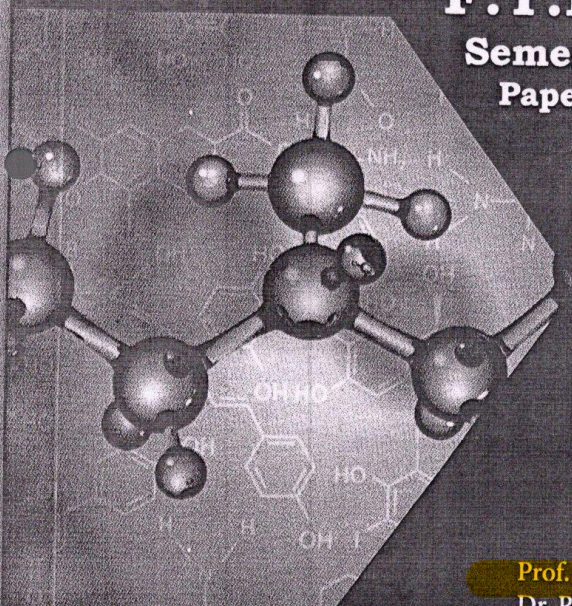




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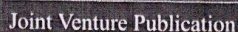


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# Organic & Inorganic Chemistry (CH-102)

**SEMESTER – I**

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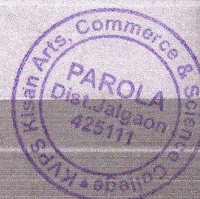
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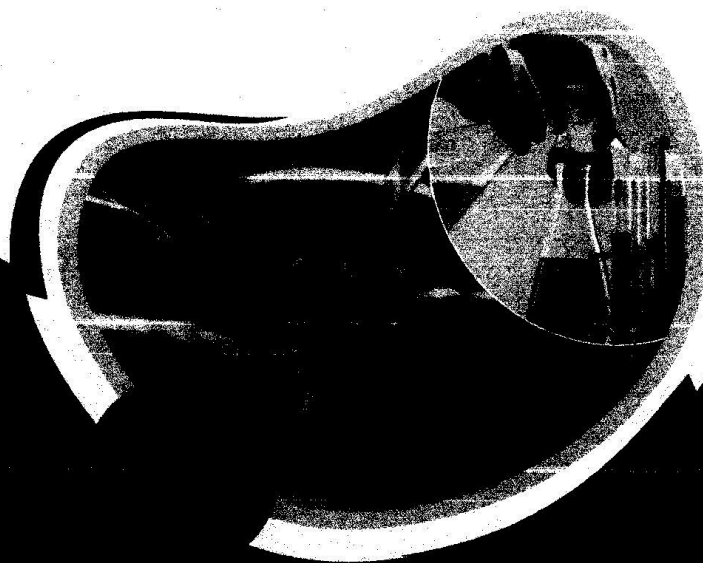
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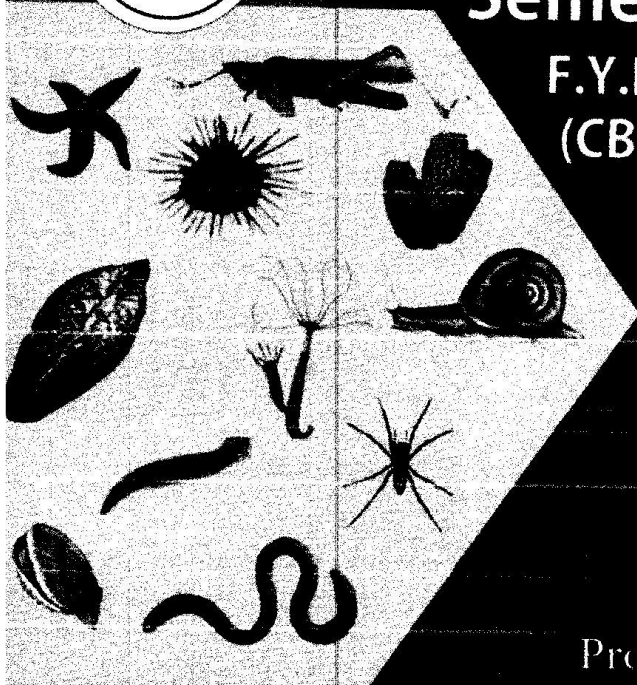
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FOR B.Sc. (F.Y.B.Sc.)  
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Practical Handbook for Course Zoo 103



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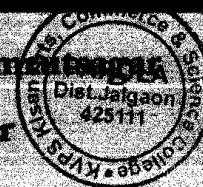
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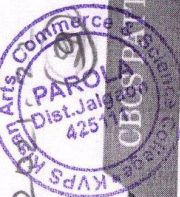
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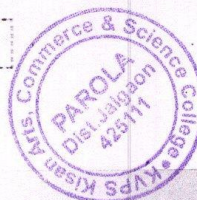
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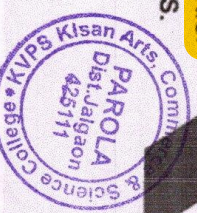
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- प्रा. डॉ. बी. टी. पाटील

इ.स. १८८५ मध्ये झालेली राष्ट्रीय काँग्रेसची स्थापना ही संपूर्ण भारतीयांसाठी केवळ राजकीयदृष्ट्याच नव्हे तर वैचारिकदृष्ट्यादेखील महत्त्वाची ठरली. त्यानंतर संपूर्ण देशभर राष्ट्रीय काँग्रेसच्या शाखा स्थापन करण्यात आल्या. देशभराप्रमाणे महाराष्ट्रातही लवकरच राष्ट्रीय काँग्रेसच्या उद्देशाप्रमाणे प्रांत, जिल्हा, तालुका पातळीपर्यंत शाखा स्थापन करण्यात आल्या. या दरम्यानच जळगाव जिल्हा काँग्रेसचीदेखील स्थापना झाली. त्यातून लोक जागृतीला चालना मिळू लागली. जळगाव जिल्ह्यास काँग्रेसच्या या विचारांसोबतच पुणे-मुंबईसारख्या शहरांतून राजकीय नेतृत्व भेटी देऊ लागले व या मोठ्या शहरात प्रसारित होणारी वृत्तपत्रेदेखील उपलब्ध होऊ लागली आणि या संपूर्ण गोष्टींच्या परिणामी जळगाव जिल्ह्यामध्ये नवविचारांचे वारे वाहू लागले. त्यामध्ये या काळात जळगावमध्ये प्रबोधचंद्रिका नावाचे साप्ताहिक सुरू होऊन स्थानिक पातळीवरही वैचारिक प्रबोधनाला सुरुवात झाली. भारतीय स्वातंत्र्य आंदोलनामध्ये जळगाव जिल्ह्याने नोंदवलेल्या सहभागामागे लोकमान्य टिळक, महात्मा गांधी अशा राष्ट्रीय पुढाऱ्यांची प्रेरणा तर होतीच याबरोबरच स्थानिक पातळीवरील अनेक पुढारी व कार्यकर्ती मंडळी यांनी उदाहरणार्थ श्री. अण्णासाहेब दास्ताने, श्री. साने गुरुजी, श्री. देवकीनंदन नारायण, श्री. धनाजी नाना चौधरी, श्री. मीर शुक्ला, श्री. लोढूभाऊ फेगडे, श्री. रामभाऊ भोगे, श्री. त्र्यंबक पांडू पाटील, श्री. माधव गोदू पाटील, श्री. उत्तमराव गिरधर पाटील, सौ. ललाताई पाटील, सौ. वारुबाई दास्ताने, सौ. पार्वती ठकार इत्यादी नेत्यांनी व जिल्ह्यातील जनसमूहाने राष्ट्रीय चळवळीमध्ये तसेच महात्मा गांधी यांच्या नेतृत्वाखालील सत्याग्रह चळवळीमध्ये महत्त्वपूर्ण सहभाग नोंदवला.<sup>१</sup>

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