

Characterization of Physical and Structural Properties of Aluminium Carbide Powder: Impact of Biofield Treatment

Mahendra Kumar Trivedi¹, Rama Mohan Tallapragada¹, Alice Branton¹, Dahryn Trivedi¹, Gopal Nayak¹, Omprakash Latiyal² and Snehasis Jana^{2*}

¹Trivedi Global Inc, 10624 S Eastern Avenue Suite A-969, Henderson, NV 89052, USA

²Trivedi Science Research Laboratory Pvt. Ltd, Hall-A, Chinar Mega Mall, Chinar Fortune City, Hoshangabad Rd., Bhopal-462026, Madhya Pradesh, India

Abstract

Aluminium carbide (Al_4C_3) has gained extensive attention due to its abrasive and creep resistance properties. Aim of the present study was to evaluate the impact of biofield treatment on physical and structural properties of Al_4C_3 powder. The Al_4C_3 powder was divided into two parts *i.e.* control and treated. Control part was remained as untreated and treated part received biofield treatment. Subsequently, control and treated Al_4C_3 samples were characterized using X-ray diffraction (XRD), surface area analyser and Fourier transform infrared spectroscopy (FT-IR). XRD data revealed that lattice parameter and unit cell volume of treated Al_4C_3 samples were increased by 0.33 and 0.66% respectively, as compared to control. The density of treated Al_4C_3 samples was reduced upto 0.65% as compared to control. In addition, the molecular weight and crystallite size of treated Al_4C_3 samples were increased upto 0.66 and 249.53% respectively as compared to control. Furthermore, surface area of treated Al_4C_3 sample was increased by 5% as compared to control. The FT-IR spectra revealed no significant change in absorption peaks of treated Al_4C_3 samples as compared to control. Thus, XRD and surface area results suggest that biofield treatment has substantially altered the physical and structural properties of treated Al_4C_3 powder.

Keywords: Biofield treatment; Aluminium carbide powder; X-ray diffraction; Fourier transform infrared spectroscopy; Surface area

Introduction

Aluminium carbide (Al_4C_3) is known for its abrasive and creep resistance properties. Generally, it is produced by reaction of aluminium with carbon in electric arc furnace [1]. Al_4C_3 plays a major role in production of some important structures such as diamond related structures, nanostructure carbons, and growth of diamonds on boron nitride etc. In addition, Al_4C_3 react with water under high pressure and generates methane [2]. Moreover, Al_4C_3 particles are used as fine dispersion in aluminium alloy to strengthen the material. In aluminium matrix, Al_4C_3 particles increase the creep resistance, especially with silicon carbide, which is widely utilizing in automobile and aircraft industries [3]. In order to improve the creep resistance of material, its crystal structure and crystallite size plays an important role. Furthermore, Al_4C_3 is also used as an abrasive material in cutting tools, where its crystallite size plays a crucial role. After considering the vast importance of Al_4C_3 in several industries, authors wish to investigate an approach that could be beneficial to modify the physical and structural properties of Al_4C_3 powder.

Energy is considered as the ability to do work, which interrelates with matter as $E=mc^2$ (Einstein's famous equation). The energy can effectively interact with any matter at a distance and cause action. In addition, energy also exists with various fields such as electric, magnetic etc. Furthermore, researchers have confirmed that bio magnetic fields are present around the human body, which have been evidenced by electromyography (EMG), Electrocardiography (ECG) and Electroencephalogram (EEG) [4]. Scientists have postulated that it is due to the flow of bioelectricity (generated from heart, brain functions or due to the motion of charged particles such as protons, electrons, and ions) in the human body. As per the basic fundamental law in physics, when an electrical signal passes through any material, a magnetic field is generated in the surrounding space [5]. Due to this, a human has ability to harness the energy from environment/universe and can transmit into any object (living or non-living) around the Globe. The

object(s) always receive the energy and responded into useful way that is called biofield energy. This process is termed as biofield treatment. These healing treatments suggest their mechanism upon modulating patient-environmental energy fields [6]. The National Center for Complementary and Alternative Medicine (NCCAM) considered this biofield treatment (therapy) in subcategory of energy therapies [7]. Furthermore, Mr. Trivedi's unique biofield treatment is known as Trivedi Effect®. Mr. Trivedi's biofield treatment has substantially altered the physical, structural and atomic characteristic in various metals [8-10] and ceramics [11,12]. Additionally, the influence of biofield treatment was significantly studied in the field of microbiology [13,14], biotechnology [15,16], and agriculture [17-19]. Recently, it was reported that biofield treatment had increased the particle size by six fold and enhanced the crystallite size by two fold in zinc powder [20]. Our group previously reported that biofield treatment has substantially altered the atomic, structural and physical properties in silicon carbide [21] and carbon allotropes [22]. Based on the outstanding results achieved by biofield treatment on metals and ceramics, an attempt was made to evaluate the effect of biofield treatment on physical and structural properties of Al_4C_3 powder.

***Corresponding author:** Dr. Snehasis Jana, Trivedi Science Research Laboratory Pvt. Ltd, Hall-A, Chinar Mega Mall, Chinar Fortune City, Hoshangabad Rd, Bhopal-462026, Madhya Pradesh, India, Tel: +91-755-6660006; E-mail: publication@trivedisrl.com

Received August 06, 2015; **Accepted** August 20, 2015; **Published** August 28, 2015

Citation: Trivedi MK, Tallapragada RM, Branton A, Trivedi D, Nayak G, et al. (2015) Characterization of Physical and Structural Properties of Aluminium Carbide Powder: Impact of Biofield Treatment. J Aeronaut Aerospace Eng 4: 142. doi:10.4172/2168-9792.1000142

Copyright: © 2015 Trivedi MK, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Experimental

The Al_4C_3 powder was purchased from Sigma Aldrich, India. The sample was equally divided into two parts, considered as control and treated. Treated group was in sealed pack and handed over to Mr. Trivedi for biofield treatment under laboratory condition. Mr. Trivedi provided the biofield treatment through his energy transmission process to the treated group without touching the sample. The control and treated samples were characterized using X-ray Diffraction (XRD), surface area analyzer, and Fourier Transform Infrared Spectroscopy (FT-IR).

X-Ray Diffraction Study

XRD analysis of control and treated Al_4C_3 powder was carried out on Phillips, Holland PW 1710 X-ray diffractometer system, which had a copper anode with nickel filter. The radiation of wavelength used by the XRD system was 1.54056 Å. The data obtained from this XRD were in the form of a chart of 2θ vs. intensity and a detailed table containing peak intensity counts, d value (Å), peak width (θ°), relative intensity (%) etc. Additionally, PowderX software was used to calculate lattice parameter and unit cell volume of Al_4C_3 powder samples. Weight of the unit cell was calculated as, molecular weight multiplied by the number of atoms present in a unit cell. Density of the unit cell was computed as follows:

$$\text{density} = \text{mass of unit cell} / \text{volume of unit cell}$$

The crystallite size (G) was calculated by using formula: $G = k\lambda / (b \cos\theta)$,

Here, λ is the wavelength of radiation used, b is full width half maximum (FWHM) and k is the equipment constant (0.94). Furthermore, the percent change in the lattice parameter was calculated using following equation:

$$\% \text{ change in lattice parameter} = \frac{[A_{\text{Treated}} - A_{\text{Control}}]}{A_{\text{Control}}} \times 100$$

where A_{treated} and A_{control} are the lattice parameter of treated and control samples respectively. Similarly, the percent change in all other parameters such as unit cell volume, density, molecular weight, and crystallite size were calculated.

Surface Area Analysis

The surface area was measured by the surface area analyser, Smart SORB 90 based on Brunauer–Emmett–Teller (BET), which had a detection range of 0.20–1000 m^2/g . Percent changes in surface area were calculated using following equation:

$$\% \text{ change in surface area} = \frac{[S_{\text{Treated}} - S_{\text{Control}}]}{S_{\text{Control}}} \times 100$$

Where, S_{control} and S_{treated} are the surface area of control and treated samples respectively.

FT-IR Spectroscopy

To see the impact of biofield treatment at bonding level in Al_4C_3 , the FT-IR analysis of control and treated Al_4C_3 samples was carried out. For FT-IR analysis, Shimadzu, Fourier transform infrared (FT-IR) spectrometer with frequency range of 300–4000 cm^{-1} was used.

Results and Discussion

X-ray diffraction (XRD)

XRD analysis results of control and treated Al_4C_3 samples are

Group	Lattice parameter (Å)	Unit cell volume ($\times 10^{-22} \text{ cm}^3$)	Density (g/cc)	Molecular weight (g/mol)	Crystallite size (nm)
Control	3.3350	2.4012	3.013	145.234	81.56
Treated, T1	3.3446	2.4149	2.996	146.064	142.59
Treated, T2	3.3429	2.4124	2.999	145.915	190.07
Treated, T3	3.3455	2.4162	2.994	146.143	285.08
Treated, T4	3.3460	2.4169	2.993	146.187	190.03

Table 1: X-ray diffraction analysis of aluminium carbide powder.

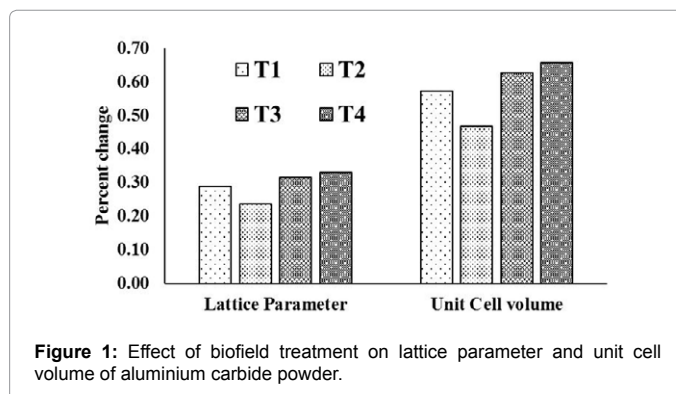


Figure 1: Effect of biofield treatment on lattice parameter and unit cell volume of aluminium carbide powder.

illustrated in Table 1 and Figures 1-3. Data showed that the lattice parameter of unit cell was increased by 0.29, 0.24, 0.31, and 0.33% in treated Al_4C_3 samples T_1 , T_2 , T_3 , and T_4 , respectively as compared to control [23]. The change in lattice parameter is also known as lattice strain (ϵ), which is related to stress (σ) by following equation:

$$\sigma = Y\epsilon$$

Where, Y is Young's Modulus

In above equation, negative and positive lattice strain indicates the compressive and tensile stress respectively. Thus, positive strain found in treated Al_4C_3 sample suggests that biofield treatment might induce tensile stress, which probably stretched the unit cell lattice parameter. Our group previously reported that biofield treatment has altered the lattice parameter in silicon carbide powder [21]. In addition, the lattice strain less than 0.2% is considered as elastic strain, while more than 0.2% is referred as plastic strain [24]. Thus, the positive lattice strain ($>0.2\%$) in treated Al_4C_3 indicates that biofield treatment probably induced plastic strain. Furthermore, the unit cell volume was increased by 0.57, 0.47, 0.63, and 0.66% in treated Al_4C_3 samples T_1 , T_2 , T_3 , and T_4 , respectively as compared to control (Figure 1). Data also showed that density was reduced by 0.57, 0.47, 0.62, and 0.65% in treated Al_4C_3 samples T_1 , T_2 , T_3 , and T_4 , respectively as compared to control. Contrarily, the molecular weight of treated Al_4C_3 was increased from 145.23 g/mol (control) to 146.06, 145.91, 146.14, and 146.18 g/mol in T_1 , T_2 , T_3 , and T_4 respectively. It suggest that molecular weight was increased by 0.57, 0.47, 0.63, and 0.66% in treated Al_4C_3 samples T_1 , T_2 , T_3 , and T_4 , respectively as compared to control (Figure 2). This could be possible if number of protons and neutrons altered after biofield treatment. Thus, it is hypothesized that a weak reversible nuclear level reaction including neutrons-protons and neutrinos might occurred in treated Al_4C_3 powders after biofield treatment [25]. It is already reported that biofield treatment has significantly altered the atomic weight and density in silicon dioxide, zirconia [26], and silicon carbide [21]. Besides this, the crystallite size of control and treated Al_4C_3 powder were computed using Scherrer formula and calculated result are presented in Table 1. Data showed that the crystallite size was

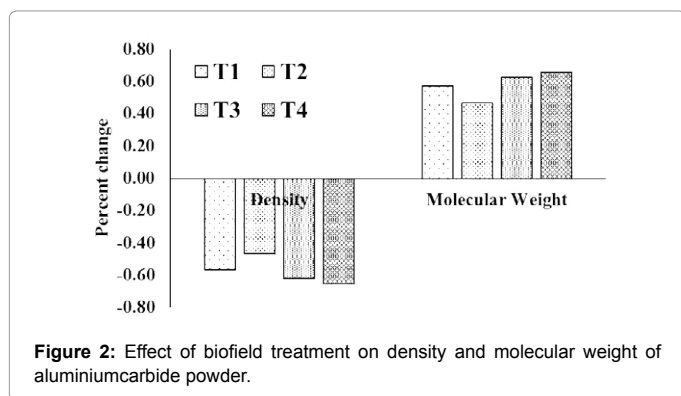


Figure 2: Effect of biofield treatment on density and molecular weight of aluminium carbide powder.

	Surface Area (m ² /g)	Percent change
Control	Treated	
1.60	1.68	5.0

Table 2: Surface area analysis of aluminium carbide powder.

increased from 81.56 nm (control) to 142.59, 190.07, 285.08, and 190.03 nm in treated Al₄C₃ samples T₁, T₂, T₃, and T₄, respectively. It suggests that crystallite size of treated Al₄C₃ powder was significantly increased by 74.83, 133.04, 249.53, and 133.0% in treated Al₄C₃ samples T₁, T₂, T₃, and T₄, respectively as compared to control (Figure 3). Previously, our group reported that biofield treatment has increased the crystallite size in antimony powder [27]. Al₄C₃ is utilized in aluminium matrix and silicon carbide to increase the creep resistance. Furthermore, Coble proposed that the strain rate in a material is inversely proportional to crystallite size as given below [28]:

$$\frac{d\varepsilon}{dt} = \frac{\sigma}{G^3} D_{gb} e^{\frac{Q_{Coble}}{RT}}$$

where σ is the applied stress, G is crystallite size, D_{gb} is diffusion coefficient in grain boundary, Q_{Coble} is activation energy for coble creep, R is gas constant, and T is temperature. Coble equation suggests that the strain rate decreases as increase in crystallite size (G) at constant temperature and stress for a given material. Further, the reduction in strain rate increases the creep resistance of a material. In Coble-creep, vacancies and atoms diffused along crystallite boundaries to elongate the crystallite along stress axis to deform the material. Thus, the increase in crystallite size in Al₄C₃ reduced the crystallite boundaries, which prevents the movement of vacancies along boundaries [29,30]. Shah et al. demonstrated that the creep resistance of metal-carbide was improved after heat treatment due to increase in crystallite size. The increase in crystallite size leads to stabilize the grain boundaries and thus improves creep resistance [31]. In addition, it was demonstrated that grain boundary sliding via slip dominates the creep process in case of finer crystallite size as compared to coarser [32]. Hence, the higher crystallite size found in treated Al₄C₃ indicates that creep resistance probably enhanced after biofield treatment as compared to control. Therefore, XRD data suggest that biofield treatment has significantly altered the atomic and structural properties in Al₄C₃.

Surface area analysis

Surface area analysis of Al₄C₃ powder is presented in Table 2. Data exhibited that surface area of treated Al₄C₃ powder was increased from 1.60 m²/g (control) to 1.68 m²/g after biofield treatment. This indicates that surface area of treated Al₄C₃ powder was slightly increased by 5.0% as compared to control. Our group previously reported that biofield

treatment has significantly reduced the particle size and increased the surface area in zirconium oxide [26]. Thus, it is assumed that the increase of surface area in treated Al₄C₃, possibly due to particle size reduction after biofield treatment. The existence of internal strains in treated Al₄C₃ was evidenced by XRD data (Figure 1), which might induce fractures in particles and reduced size. Hence, it is concludes that biofield treatment has altered the physical characteristics of Al₄C₃ powder as compared to control.

FT-IR analysis

FT-IR spectra of control and treated Al₄C₃ samples are illustrated in Figure 4. In control Al₄C₃ samples absorption peaks were observed at 499, 609, 711, and 785 cm⁻¹, which could be due to Al-C bonding vibrations. The control data is well supported by literature data [33]. The treated Al₄C₃ also showed similar absorption peaks at 499, 609, 709, and 785 cm⁻¹, which could be assigned Al-C bonding vibrations. Furthermore, peaks observed at 1490 and 1440 cm⁻¹ in control and treated Al₄C₃ respectively, could be due to moisture absorption. In addition, the peaks observed at 2358 and 2395 cm⁻¹ in control and treated Al₄C₃ respectively, could be due to CO₂ absorption by samples. Thus, FT-IR data suggest that no significant change was observed in absorption peaks of treated Al₄C₃ as compared to control.

Conclusion

Biofield treatment showed an increased lattice parameter and unit cell volume of treated Al₄C₃ samples upto 0.33 and 0.66% respectively,

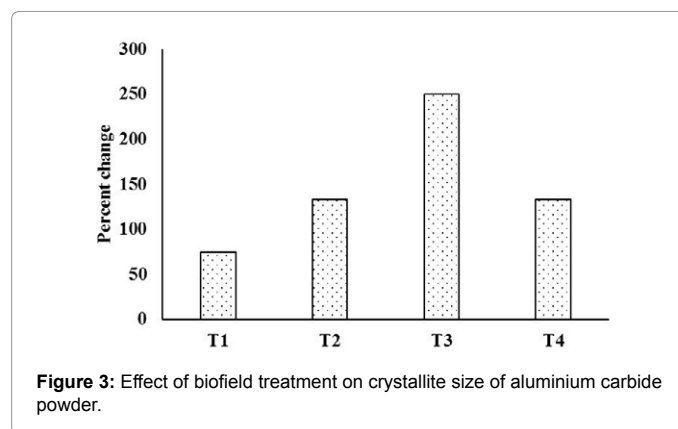


Figure 3: Effect of biofield treatment on crystallite size of aluminium carbide powder.

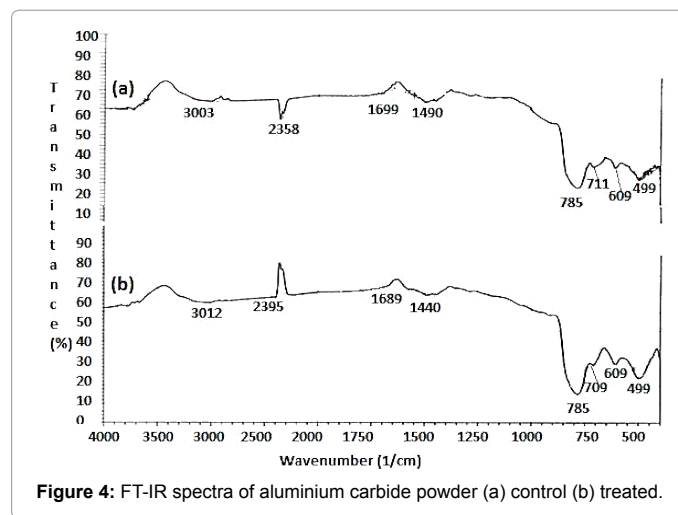


Figure 4: FT-IR spectra of aluminium carbide powder (a) control (b) treated.

as compared to control. It may be due to tensile stress, which probably generated in treated Al_4C_3 samples after biofield treatment. In addition, the molecular weight was increased upto 0.66% in treated Al_4C_3 samples as compared to control. It is hypothesized that biofield treatment may induce nuclear level reaction, which resulted into increase of molecular weight in treated Al_4C_3 sample. Besides, the crystallite size of treated Al_4C_3 samples was significantly increased upto 285.08 nm from 81.56 nm (in control). The increase in crystallite size could improve the creep resistance and abrasive properties of treated Al_4C_3 samples. Furthermore, the surface area was increased by 5% in treated Al_4C_3 samples as compared to control. It could be due to alteration of shape/size of Al_4C_3 particles after biofield treatment. However, no significant change was observed in absorption peaks in FT-IR spectra of treated Al_4C_3 as compared to control. Therefore, based on above outcomes of XRD and surface area analysis, it is assumed that treated Al_4C_3 with high creep resistance could be more useful in automobile and aircraft manufacturing industries.

Acknowledgement

Authors gratefully acknowledged to Dr. Cheng Dong of NLSC, Institute of Physics, and Chinese academy of Sciences for providing the facilities to use PowderX software for analyzing XRD data. Authors also would like to thank Trivedi science, Trivedi master wellness and Trivedi testimonials for their support during the work.

References

- Greenwood NN, Earnshaw A (1997) Chemistry of the Elements. Butterworth-Heinemann.
- Ji C, Ma Y, Chyu MC, Knudson R, Zhu H (2009) X-ray diffraction study of aluminum carbide powder to 50 GPa. J Appl Phys 106: 083511.
- Zhu SJ, Peng LM, Zhou Q, Ma ZY, Kucharova K, et al. (1998) Creep behaviour of aluminium strengthened by fine aluminium carbide particles and reinforced by silicon carbide particulates DS Al-SiC/Al₄C₃ composites. Mater Sci Eng A 268: 236-245.
- Zahra M, Farsi M (2009) Biofield therapies: Biophysical basis and biological regulations. Complement Ther Clin Pract 15: 35-37.
- Maxwell JC (1865) A dynamical theory of the electromagnetic field. Phil Trans R Soc Lond 155: 459-512.
- Aldridge D (1991) Spirituality healing and medicine. Br J Gen Pract 41: 425-427.
- Hok J, Tishelman C, Ploner A, Forss A, Falkenberg T (2008) Mapping patterns of complementary and alternative medicine use in cancer: An explorative cross-sectional study of individuals with reported positive exceptional experiences. BMC Complement Altern Med 8: 48.
- Trivedi MK, Patil S, Tallapragada RM (2012) Thought intervention through bio field changing metal powder characteristics experiments on powder characteristics at a PM plant. Future Control and Automation LNEE 173: 247-252.
- Trivedi MK, Patil S, Tallapragada RM (2015) Effect of biofield treatment on the physical and thermal characteristics of aluminium powders. Ind Eng Manage 4: 151.
- Trivedi MK, Patil S, Tallapragada RM (2013) Effect of biofield treatment on the physical and thermal characteristics of silicon, tin and lead powders. J Material Sci Eng 2: 125.
- Trivedi MK, Patil S, Tallapragada RM (2013) Effect of biofield treatment on the physical and thermal characteristics of vanadium pentoxide powder. J Material Sci Eng S11: 001.
- Trivedi MK, Nayak G, Patil S, Tallapragada RM, Latiyal O (2015) Studies of the atomic and crystalline characteristics of ceramic oxide nano powders after bio field treatment. Ind Eng Manage 4: 161.
- Trivedi MK, Patil S, Shettigar H, Gangwar M, Jana S (2015) Antimicrobial sensitivity pattern of *Pseudomonas fluorescens* after biofield treatment. J Infect Dis Ther 3: 222.
- Trivedi MK, Patil S, Shettigar H, Bairwa K, Jana S (2015) Phenotypic and biotypic characterization of *Klebsiella oxytoca*: An impact of biofield treatment. J Microb Biochem Technol 7: 203-206.
- Patil S, Nayak GB, Barve SS, Tembe RP, Khan RR (2012) Impact of biofield treatment on growth and anatomical characteristics of *Pogostemon cablin* (Benth). Biotechnology 11: 154-162.
- Nayak G, Altekar N (2015) Effect of biofield treatment on plant growth and adaptation. J Environ Health Sci 1: 1-9.
- Shinde V, Sances F, Patil S, Spence A (2012) Impact of biofield treatment on growth and yield of lettuce and tomato. Aust J Basic and Appl Sci 6: 100-105.
- Lenssen AW (2013) Biofield and fungicide seed treatment influences on soybean productivity, seed quality and weed community. Agricultural Journal 8: 138-143.
- Sances F, Flora E, Patil S, Spence A, Shinde V (2013) Impact of biofield treatment on ginseng and organic blueberry yield. Agrivita J Agric Sci 35.
- Trivedi MK, Tallapragada RM (2008) A transcendental to changing metal powder characteristics. Met Powder Rep 63: 22-28, 31.
- Trivedi MK, Nayak G, Tallapragada RM, Patil S, Latiyal O, et al. (2015) Effect of biofield treatment on structural and morphological properties of silicon carbide. J Powder Metall Min 4: 1.
- Trivedi MK, Tallapragada RM (2009) Effect of super consciousness external energy on atomic, crystalline and powder characteristics of carbon allotrope powders. Mater Res Innov 13: 473-480.
- Soboyejo W (2002) Mechanical properties of engineered materials. CRC press.
- Daymond MR, Bourke MAM, Dreele RBV, Clausen B, Lorentzen T (1997) Use of Rietveld refinement for elastic macrostrain determination and for evaluation of plastic strain history from diffraction spectra. J Appl Phys 82: 1554-1562.
- Narlikar JV (1993) Introduction to cosmology. (2nd edn), Jones and Bartlett Inc Cambridge University Press.
- Trivedi MK, Patil S, Tallapragada RM (2014) Atomic crystalline and powder characteristics of treated zirconia and silica powders. J Material Sci Eng 3: 144
- Dhabade VV, Tallapragada RM, Trivedi MK (2009) Effect of external energy on atomic, crystalline and powder characteristics of antimony and bismuth powders. Bull Mater Sci 32: 471-479.
- Chawla KK (1999) Mechanical Behavior of Materials. (1st edn) Prentice Hall.
- Lu L, Sui ML, Lu K (2000) Superplastic extensibility of nanocrystalline copper at room temperature. Science 287: 1463-1466.
- Yamakova V, Wolfa D, Phillpota SR, Gleiterb H (2002) Grain-boundary diffusion creep in nanocrystalline palladium by molecular-dynamics simulation. Acta Materialia 50: 61-73.
- Sha JJ, Nozawa T, Park JS, Katoh Y, Kohyama A (2004) Effect of heat treatment on the tensile strength and creep resistance of advanced SiC fibers. J Nucl Mater 329: 592-596.
- Sherby OD, Taleff EM (2002) Influence of grain size solute atoms and second-phase particles on creep behavior of polycrystalline solids. Mater Sci Eng A322: 89-99.
- Meyer FD, Hillebrecht H (1998) Synthesis and crystal structures of ternary phases in the system Al/C/N. European Crystallographic Meeting. Praha, Czech Republic.