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Research Article Open Access

# Physical, Atomic and Thermal Properties of Biofield Treated Lithium Powder

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**Abstract**

Lithium has gained extensive attention in medical science due to mood stabilizing activity. The objective of the present study was to evaluate the impact of biofield treatment on physical, atomic, and thermal properties of lithium powder. The lithium powder was divided into two parts i.e., control and treatment. Control part was remained as untreated and treatment part received Mr. Trivedi's biofield treatment. Subsequently, control and treated lithium powder samples were characterized using X-ray diffraction (XRD), Differential scanning calorimetry (DSC), Thermogravimetric analysis-differential thermal analysis (TGA-DTA), Scanning electron microscopy (SEM) and Fourier transform infrared spectroscopy (FT-IR). XRD data showed that lattice parameter, unit cell volume, density, atomic weight, and nuclear charge per unit volume of lithium were altered after biofield treatment. The crystallite size of treated lithium was increased by 75% as compared to control. DSC analysis exhibited an increase in melting temperature of treated lithium powder upto 11.2% as compared to control. TGA-DTA analysis result showed that oxidation temperature, which found after melting point, was reduced upto 285.21°C in treated lithium as compared to control (358.96°C). Besides, SEM images of control and treated lithium samples showed the agglomerated micro particles. Moreover, FT-IR analysis data showed an alteration in absorption band (416→449 $cm^{-1}$) in treated lithium sample after biofield treatment as compared to control. Overall, data suggested that biofield treatment has significantly altered the physical, atomic, and thermal properties of lithium powder.

**Keywords**: Biofield treatment; Lithium; X-ray diffraction; Differential scanning calorimetry; Thermogravimetric analysis-differential thermal analysis; Scanning electron microscopy; Fourier transform infrared spectroscopy

## Introduction

Lithium is highly reactive, light metal, which is commonly found in various foods such as grains, vegetables, mustard, kelp, and fish blue corn etc. Several lithium salts are used as mood stabilizing drugs, mainly in the treatment of bipolar disorder [1]. Lithium is primarily responsible to prevent mania and reduces the risk of suicide tendency in humans [2]. Overall, in placebo-controlled trials, lithium has been found useful as an adjunct medication for 45% of patients [3]. In addition, it is widely spread in central nervous system and interacts with many neurotransmitters and receptors, thus increasing serotonin synthesis [4]. Further, it is also reported that lithium ions ($Li^+$) can increase the release of serotonin or 5-hydroxy tryptamine by neurons in the brain [5]. Furthermore, the most commonly prescribed lithium salts include lithium carbonate ($Li_2CO_3$), lithium orotate ($C_5H_3LiN_2O_4$), and lithium citrate ($Li_3C_6H_5O_7$) for pharmacological treatment in mentally disordered patients [6,7]. Thus, by conceiving the usefulness of lithium in pharmaceutical industry, the present study was attempted to investigate an alternative way, which can modify the physical, atomic and thermal properties of lithium powder.

Harold Saton Burr had performed the detailed studies on the correlation of electric current with physiological process and concluded that every single process in the human body had an electrical significance [8]. Recently, it was discovered that all electrical process happening in body have strong relationship with magnetic field as mentioned by Ampere's law ($\oint B.dl = \mu_o I$) which states that the moving charge produces magnetic fields in surrounding space [9,10]. Thus, the human body emits the electromagnetic waves in form of bio-photons, which surrounds the body and it is commonly known as biofield. Therefore, the biofield consists of electromagnetic field, being generated by moving electrically charged particles (ions, cell, molecule etc.) inside the human body. Further, electrocardiography has been extensively used to measure the biofield of human body [11]. Thus, human has the ability to harness the energy from environment or universe and can transmit into any living or non-living object(s) around the Globe. The objects always receive the energy and responding into useful way that is called biofield energy and the process is known as biofield treatment. Mr. Trivedi's unique biofield treatment (The Trivedi effect®) has been known to transform the structural, physical and thermal properties of metals [12,13] and ceramics [14] in material science. In addition biofield treatment had improved the growth and production of agriculture crops [15-17], significantly altered the phenotypic characteristics of various pathogenic microbes [18,19], and altered the medicinal, growth and anatomical properties of ashwagandha [20].

Based on the excellent outcomes of biofield treatment, authors were interested to investigate the effect of biofield treatment on physical, atomic and thermal characteristics of lithium powder using X-ray diffraction (XRD), Differential Scanning Calorimetry (DSC), Thermogravimetric analysis-differential thermal analysis (TG-DTA), Scanning electron microscopy (SEM), and Fourier transform infrared spectroscopy (FT-IR).

## Materials and Methods

The lithium powder was purchased from Alfa Aesar, USA. The sample was equally divided into two parts, considered as control and

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treatment. Control part was remained untreated and treatment group was subjected to Mr. Trivedi's biofield energy treatment.

### Biofield energy treatment

The treatment sample was in sealed pack, handed over to Mr. Trivedi for biofield treatment under laboratory conditions. 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 XRD, DSC, TGA-DTA, SEM, and FT-IR.

### X-ray diffraction (XRD) study

XRD analysis of control and treated lithium 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 Kapton tapes were used to prevent the oxidation of the samples from air. 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 control and treated lithium powder samples. The crystallite size (G) was calculated by using Scherrer formula:

G=kλ/(bCosθ),

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:

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

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

### Differential scanning calorimetry (DSC)

Differential Scanning Calorimeter (DSC) of Perkin Elmer/ Pyris-1, USA, with a heating rate of 10°C/min and nitrogen flow of 5 mL/min was used. The melting point and latent heat of fusion of control and treated lithium were recorded from their respective DSC curves. This system had accuracy of ± 0.2 K in the measurement of melting point.

The percent change in melting point was computed using following equations:

$$\%\,change\,in\,melting\,point = \frac{\left[T_{Treated} - T_{Control}\right]}{T_{Control}} \times 100$$

Where, $T_{Control}$ and $T_{Treated}$ are the melting point of control and treated samples, respectively. Similarly, the percent change in the latent heat of fusion was computed.

### Thermogravimetric analysis-differential thermal analysis (TG-DTA)

For TG-DTA analysis, Mettler Toledo simultaneous TG and Differential thermal analyser (DTA) was used. The samples were heated from room temperature to 400°C with a heating rate of 5°C/ min under air atmosphere.

### Scanning electron microscopy (SEM)

Surface morphology is the unique properties of lithium powder. Control and treated lithium samples were observed using JEOL JSM-6360 SEM instrument at 2000X magnification. In order to prevent the sample from oxidising, the environment holder and airlock system were used. With the help of these systems, the sample were prepared and mounted on environmental holder in a sealed glove box and kept in SEM for analysis. The differences in the tendency of the particles to clump were easily seen at the lower magnifications, while variations in size and morphology become clearer at higher magnification [21].

### Fourier transform infrared spectroscopy (FT-IR)

FT-IR spectroscopic analysis was carried out to evaluate the impact of biofield treatment at atomic and molecular level like bond strength, stability, and rigidity of structure etc. FT-IR analysis of control and treated Lithium samples were performed on Shimadzu, Fourier transform infrared (FT-IR) spectrometer with frequency range of 300-4000 $cm^{-1}$.

## Results and Discussion

### X-ray diffraction (XRD) study

XRD diffractograms of control and treated lithium powders are shown in Figure 1. XRD patterns of control sample showed intense peaks at 2θ equal to 32.58°, 35.56°, 35.74°, 36.13°, 51.48°, 51.87°, 64.57° and 76.73°. However, crystalline peaks in treated lithium sample were observed at 2θ equal to 32.67°, 36.15°, 52.16°, 64.56°, 64.84° and 65.02°. The intense peaks were found in both control and treated samples indicated the crystalline nature of lithium powder. Furthermore, the peaks intensity at 2θ equal to 36.15° and 52.16° in treated samples were significantly reduced as compared to control. Whereas, the intensity of peak at 64.57° (control), which shifted to 64.84° (treated), was increased after biofield treatment. The intensity of the diffraction peaks are determined by the arrangement of atoms in the entire crystal and it sums the result of scattering from all atoms in the unit cell to form a diffraction peak (2θ) from the particular planes of atoms [22,23]. In addition, long range order of atoms along a plane shows higher intensity in XRD as compared to atoms with short range order. Thus, the alteration in intensity of XRD peaks in treated lithium powder as compared to control indicated that arrangement of atoms probably changed after biofield treatment. It is possible that atoms situated along the plane corresponding to 2θ equal to 36.15° and 52.16° may reorient themselves in another direction i.e., along plane attributed to 2θ equal to 64.57°, after biofield treatment. For further analysis, the XRD peaks were indexed with body centred cubic (BCC) crystal structure [24] and crystal structure parameters such as lattice constant, unit cell volume etc. were computed using PowderX software and results are presented in Table 1.

Data exhibited that lattice parameter and unit cell volume of treated lithium powder were reduced by 0.15 and 0.46%, respectively as compared to control. The reduction of lattice constant and unit cell volume indicated that a compressive strain might present in unit cell of treated lithium. It is assumed that biofield energy, which probably transferred through biofield treatment, might induce a compressive stress in treated sample. It is reported that high stress on lithium unit cell can change the crystal structure from BCC to face centred cubic (FCC) [25]. Previously, our group reported that biofield treatment had altered the unit cell volume in carbon allotropes [26]. Furthermore, the density and nuclear charge per unit volume of treated lithium powder were increased by 0.45 and 0.46%, respectively; however atomic weight was

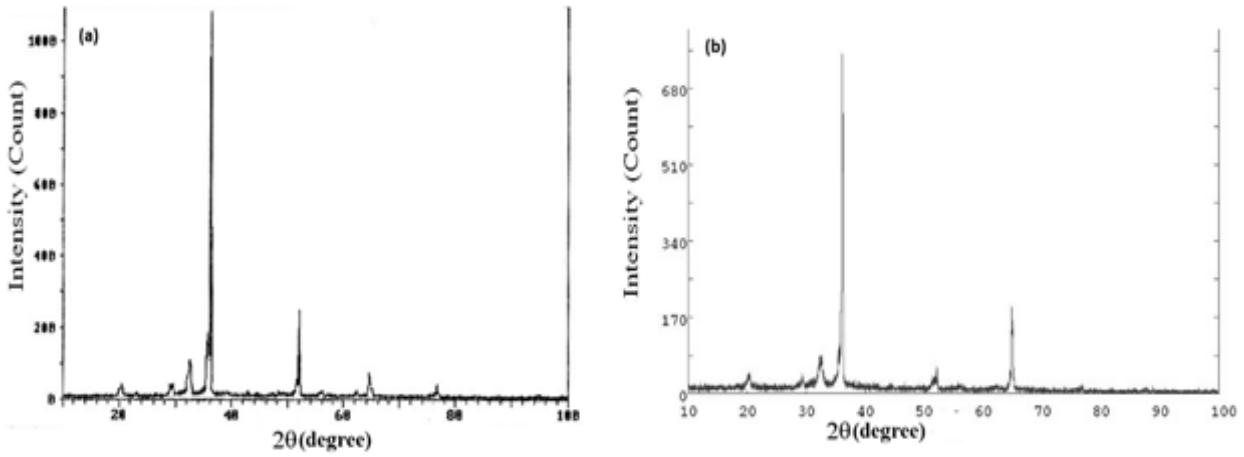


**Figure 1:** X-ray diffraction (XRD) pattern of lithium powder (a) Control (b) Treated.

| Group | Lattice parameter (Å) | Unit Cell volume ($\times 10^{-23}$ cm$^3$) | Density (g/cc) | Molecular weight (g/mol) | Nuclear charge per unit volume (C/m$^3$) | Crystallite size (nm) |
|---|---|---|---|---|---|---|
| Control | 3.52 | 4.36 | 0.537 | 7.06 | 21005 | 62.17 |
| Treated | 3.51 | 4.34 | 0.539 | 7.03 | 21102 | 108.80 |
| Percent Change | -0.14 | -0.46 | 0.46 | -0.45 | 0.46 | 75.0 |

**Table 1:** X-ray diffraction (XRD) analysis result of control and treated lithium powder samples.

reduced (7.060→7.028) by 0.46% as compared to control. The increase in nuclear charge per unit volume indicated that nuclear strength of $Li^+$ ions in treated lithium powder probably increased after biofield treatment. It is reported that $Li^+$ plays an important role in central nervous system in releasing the serotonin from neurons [5,27,28]. Thus, it is assumed that serotonin releasing activity of $Li^+$ in treated sample may be higher as compared to control. Besides, crystallite size (G), computed using Scherrer formula ($G=k\lambda/b\cos\theta$), are presented in Table 1. The crystallite size was increased from 62.17 nm (control) to 108.8 nm in treated lithium powder after biofield treatment. It indicated that crystallite size of lithium powder was significantly increased by 75% as compared to control, after biofield treatment. It is reported that crystallite size of metals and ceramics can be increased by increasing the temperature [29,30]. Recently, the increase in crystallite size in nickel and copper through biofield treatment had been reported by our group [31]. Thus, it is assumed that the energy transferred through biofield treatment probably initiated the movement of crystallite boundaries, which might lead to increase the crystallite size. Hence, XRD data revealed that biofield treatment has altered the physical and structural properties of lithium powder.

## Differential scanning calorimetry (DSC)

Melting point and latent heat of fusion are the two key parameters for thermal analysis of metal powder. Fundamentally, melting point is related to the kinetic energy (thermal vibration) of atoms, whereas the potential energy is the energy required to overcome the interatomic interaction for phase change, which is related to latent heat of fusion ($\Delta H$) [32]. The melting temperature and latent heat of fusion of control and treated lithium powder are presented in Table 2. The melting temperature of control lithium sample was found at 181.86°C which changed to 181.20°C, 202.21°C, and 200.34°C in treated samples i.e., T1, T2, and T3, respectively. It showed that melting temperature of treated lithium powder was increased by 11.2 and 10.2% in T2 and T3, respectively, though it was slightly decreased (0.36%) in T1, as compared to control. Thus, the alteration of melting point was found in treated lithium powder indicated that the thermal vibrations of atoms probably changed after biofield treatment. The latent heat of fusion in control sample was 309.15 J/g, which changed to 42.41, 234.48, and 404.38 J/g in treated lithium T1, T2, and T3, respectively as compared to control. Recently, our group reported that biofield treatment had altered the melting point and $\Delta H$ in lead and tin powder [33]. In addition, the change in $\Delta H$ suggests that potential energy of treated lithium atoms possibly changed after biofield treatment. Thus, it is assumed that the biofield treatment probably transferred the energy to lithium powder and that might be responsible for alteration in kinetic and potential energy of treated atoms. Additionally, the increase in melting temperature in treated sample also suggests that interatomic interaction of treated lithium probably enhanced after biofield treatment. Furthermore, it is reported that $Li^+$ interact with nitric oxide (NO) in CNS of human, which plays a crucial role in the neural plasticity [34,35]. The interaction of two atoms directly depends on their mobility and interatomic interaction of respective atoms [36]. Hence it is assumed that the alteration in interatomic interaction of treated lithium atoms may change the interaction of $Li^+$ with NO and that can ultimately influence the mood stabilizing activity of lithium.

## Thermogravimetric analysis-differential thermal analysis (TG-DTA)

Analysis result of TG-DTA is presented in Table 3. Data showed the exothermic peak at 358.96°C (control), which reduced to 305.42°C, 349.56°C, 285.21°C and 328.06°C in treated lithium samples i.e., T1, T2, T3, and T4, respectively. It could be due to oxidation of control and treated lithium powder samples. It indicated that oxidation temperature was reduced by 14.9, 2.61, 20.5, and 8.60% in treated lithium powder T1, T2, T3, and T4, respectively as compared to control. The reduction of oxidation temperature of treated samples as compared to control indicated that thermal stability of lithium powder probably decreased after biofield treatment. Therefore, based on DSC and TG-DTA data, it

| Parameter | Control | T1 | T2 | T3 |
|---|---|---|---|---|
| Melting Temperature (°C) | 181.86 | 181.20 | 202.21 | 200.34 |
| Percent change | - | -0.36 | 11.2 | 10.2 |
| Latent heat of fusion, ΔH (J/g) | 309.15 | 42.41 | 234.48 | 404.38 |
| Percent change in ΔH | - | -86.3 | -24.1 | 30.8 |

**Table 2:** Differential scanning calorimetry (DSC) analysis of control and treated of lithium powder samples.

| Parameter | Control | T1 | T2 | T3 | T4 |
|---|---|---|---|---|---|
| Oxidation Temperature (°C) | 358.96 | 305.42 | 349.56 | 285.21 | 328.06 |
| Percent increase/ decrease | | -14.9 | -2.61 | -20.5 | -8.60 |

**Table 3:** Thermogravimetric analysis-differential thermal analysis (TG-DTA) of control and treated lithium powder samples.

is concluded that biofield treatment has altered the thermal behaviour of lithium powder.

### Scanning electron microscopy (SEM)

SEM images of control and treated lithium powders are shown in Figure 2. It showed that powder particles were irregular and highly agglomerated in control and treated lithium powders. The SEM micrograph of control showed inter-particles and inter-agglomerated boundaries whereas treated sample showed the possible fracture and welding at the surface on the particles. Recently, our group had studied the effect of biofield treatment on antimony and bismuth powders using SEM, in which fractured surfaces were observed after treatment [37]. Thus, it is assumed that biofield treatment may induce the fracture in treated powder particles, which led to generate fresh surfaces. Further, these fresh surfaces welded together to form agglomerated powders. Therefore, SEM images revealed that biofield treatment has altered the surface morphology of lithium powder.

### Fourier transform infrared spectroscopy (FT-IR)

The FT-IR spectrum serves as compound's fingerprint and provides specific information about chemical bonding and molecular structure. Thus FT-IR is more advanced and powerful analytical tool for characterization and identification of molecules. The FT-IR spectra of control and treated lithium powders are presented in Figure 3. In these spectra, the absorption band was observed at 3566 and 3674 $cm^{-1}$ in control and treated lithium samples respectively, which were attributed to O-H stretching vibrations. Brooker et al. reported that the lithium compounds are highly air-sensitive so it can absorb the air and water easily [38]. Thus, it is possible that the lithium metal powder used in this experiment may absorb moistures from the environment. Due to which, the O-H bands were emerged in FT-IR spectra of control and treated samples. Furthermore, the absorption band found at 862, 1001, and 1446 $cm^{-1}$ in control and 867, 1085, and 1446 $cm^{-1}$ in treated sample were corresponding to bending, symmetric stretching, and asymmetric stretching vibrations of $-CO_3$ group. The emergence of $-CO_3$ band could be due to $CO_2$ absorption by samples. In addition, the absorption band corresponding to Li-O bond vibrations was observed at 416 $cm^{-1}$ in control and it was shifted to 449 $cm^{-1}$ in treated lithium sample. Simonov et al. reported the Li-O bond vibration at around 428 $cm^{-1}$ in lithium containing compound [39]. Recently, our group reported that the alteration of absorption band in FT-IR spectra of zinc oxide, iron oxide, and copper oxide powders after biofield treatment [40]. Thus, based on this, it is assumed that biofield energy treatment might alter the bonding properties in lithium powder.

## Conclusion

XRD data showed that biofield treatment results in reduction of unit cell volume and atomic weight by 0.46% as compared to control; however density and nuclear charge per unit volume were increased by 0.45 and 0.46%, respectively as compared to control. Based on the increase in nuclear charge per unit volume in treated lithium sample, it is assumed that nuclear strength of $Li^+$ ions might enhanced after biofield treatment. It may lead to increase the efficacy of $Li^+$ ions in human brain as mood stabilizer. Besides, the crystallite size was increased from 62.17 nm (control) to 108.8 nm in treated lithium powder. The melting point of treated lithium was increased upto 202.21°C as compared to control (181.86°C). Further, the change in melting point can be correlated with the change in interatomic interaction of treated lithium atoms after biofield treatment. It is assumed that the change in interatomic interaction may lead to alter the interaction of $Li^+$ ions with NO in CNS of human. In addition, TG-DTA study revealed that oxidation temperature of lithium was reduced upto 285.21°C as compared to control (358.96°C). SEM image of treated lithium sample showed the fractured and welded surface as compared to inter-particle and agglomerated boundaries in control. FT-IR result showed that, Li-O bond in treated sample (449 $cm^{-1}$) was altered as compared to control (416 $cm^{-1}$). Overall, data suggested that biofield treatment has altered the physical, atomic, and thermal properties of lithium powder. Therefore, it is assumed that biofield treated lithium powder could be more useful in mood stabilizer drug as compared to control.

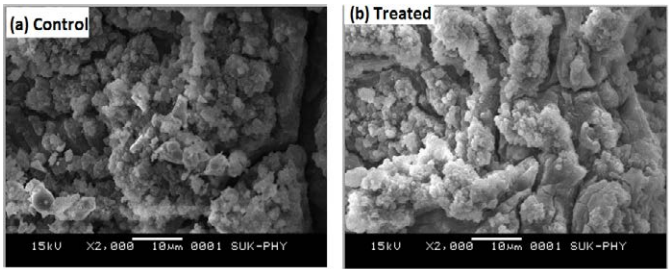


**Figure 2:** Scanning electron microscope (SEM) images of lithium powder.

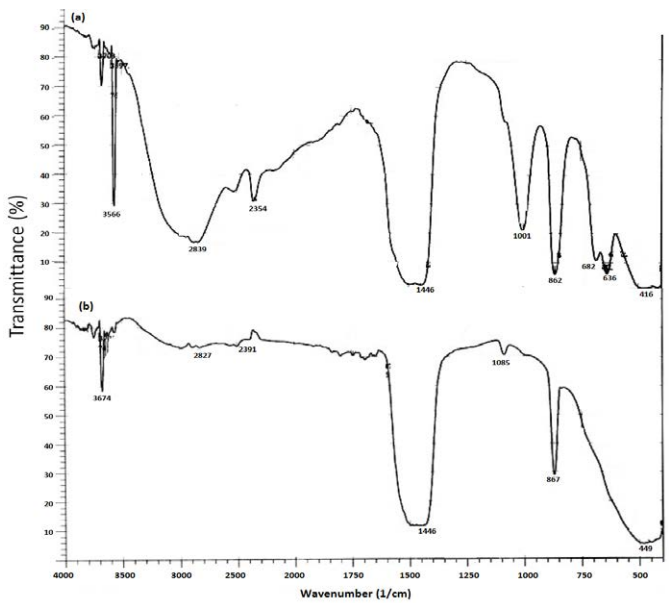


**Figure 3:** FT-IR spectrum of lithium powder (a) Control and (b) Treated.

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