1. **Title:** Synthesis of Novel Carbon material using Microbes

2. **Name/s of Investigator/s with Department:** Dr. Elcey CD, Department of Life Sciences

**3. Abstract:**

a) **Problem statement-** The organic compounds have a definite quantity of carbons which is arranged in a particular manner emphasis their utility. The solid fossil reserve which is widely exploited is the coal. It is a mixture of organic compounds. Minerals present in coal add its complexity which leads to pollution upon burning and other environmental complications. Structure of coal decided by the material it formed from and the condition it undergone ages. These carbonaceous compound are further refined to form another set of structured carbon material ie., Graphite or diamond. Carbon in coal is without a definite arrangement whereas its proper order in structure determines the type of compound and its utilization. In Graphite the carbon atoms are arranged in hexagon stalks one top of the other with weak force between molecules enable it to possess conductivity. Whereas in Diamond each carbon atom has strong tetrahedral units in which each carbon has covalent bonds to form three dimensional rigid structures. Industrial production of graphite from coal is a tedious process where involve the intense heating as high as 3,630$^{o}$ C to cook the coal to remove the inorganic minerals and gases. The resultant powder then mixed with silicon in electric furnace to form Silicon carbide which in turn heat at 7,500o to release graphite.

b) **Objectives,** Transformation of carbon compounds using Biotechnology processes/ green processes is an ongoing investigation. Certain microorganisms both Bacteria and Fungi can utilize the energy by breaking down the complex compounds. Such activity of microorganisms can be demonstrated for the structural conversion of coal/ lignite by gradual and systematic decomposition which lead to the formation of high value product.

The present study was carried out to understand the changes that happens within the low grade coal samples (lignite) when treated with microorganisms. For the analysis the Lignite samples were collected from a nearby Lignite field and the collected samples were stored in dark till further use.

c) methods

Lignite samples were collected from Lignite fields of Naively, Tamil Nadu. These samples were grown in Nutrient broth and Czapek Dox medium to enrich the native organisms. The

organisms grown in the medium were isolated, categorized and identified using biochemical test followed by molecular identification. These organisms were grown for the inoculum separately and constituted as a consortium and inoculated in 200 ml Czapek Dox medium along with 10 grams each of Lignite samples. Three sets of experiment were carried out with different inocula, ie., the *Aspegillus niger alone*, the bacterial consortium alone and a consortium of *Asperillus niger* with all the isolated bacterial strains and, along with the Lignite samples in Czapek Dox medium. The chemical constitution and structural modification of the lignite were compared with the control after the incubation. The experiments were continued in different cycles of same intervals with similar sets of inoculum. After the incubation period of 15 days, the Lignite samples were separated washed, dried and analysed. The media and the culture filtrate also were analysed for the change in pH at regular intervals up to the completion of the individual cycle of experiment and to analyse the minerals released in the filtrate. Weight of the lignite samples also was taken after the completion of each cycle and the difference in weight were recorded.

d) Major Findings / Results

1. The bacterial strains isolated from the lignite samples were identified as (a) *Paenibacillus* sp. N33621UB06, (b) *Paenibacillus illinoisensis* strain Z011 (c) *Bacillus subtilis* strain HR05

2. Impurities of Lignite which hinder the energy efficiency is removed by the process of bioleaching by the microorganism upon co-culturing.

3. Structural change in lignite samples confirm the conversion of the same into more integrated and high value carbon material ie., graphite.

4. Consortium of organisms ie., Fungi and bacteria were more efficient than the individual organisms in Bioleaching and bioconversion

4. Publication / patent details (if any): Publication in progress