THz spectroscopic characterization of biochar

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***Abstract*—.Fertile dark soils made by humans in the Amazon basin, terra preta, have influenced the manufacture of the biochar based fertilizers. Different types of biochar exist but not all of them are good in improving the quality of the soil. FTIR was used to distinguish between the more and the less fertile biochar.**

I. INTRODUCTION

BIOCHAR is a key ingredient for artificial fertilizers which have been made in an attempt to replicate fertile human-made dark soils from the Amazon also known as terra preta [1,2]. Previous research has detailed that an important difference between terra preta and reference soils is the content of aromatic carbons [1].

It is not clear why tera preta is fertile, despite extensive research being carried out to determine what gives them the remarkable fertility. Some of the biochar has been found to improve the soil quality while some are not good fertilizers. This however, has not discouraged scientists to pursue the biochar research as there are various groups carrying out research in this field. A success in the replication of the Amazonian soils will mean that their exact constituents are known which will tailor the manufacturing of the boichar to specific crop production. This calls for better methods of screening as well as characterization of both the terra preta and biochar-based fertilizers.

Terahertz spectroscopy has been found to be an effective tool in characterization and identification of materials. This has been possible because THz radiation has an ability to penetrate many materials may it be, wood, cardboard or glass. Its low photon energy allows for the studies of materials with no fear of any chemical alteration. Various techniques have been utilized in the studies of these materials such as nuclear magnetic resonance [3]. It is however important to develop much simpler, quicker and more accessible techniques and thus THz spectroscopic techniques are better suited. Fourier transform infrared spectrometer was used to measure the transmission spectra of experimental fertilizer BMC6 (a mixture of eucalyptus saligna biochar, mineral compounds and clay), a pure biochar named bamboo biochar and 2, 4-dinitrotoluene. A globar was used as a source of radiation while a liquid helium cooled bolometer was used for radiation detection.

II. RESULTS

Figure 1 shows the transmission spectra of BMC6 which is a prototype fertilizer, bamboo biochar and 2,4-dinitrotoluene. From this it can be seen that there are common peaks between BMC6 and 2, 4-dinitrotoluene which suggests that BMC6 is rich in pure aromatic compounds which are believed to be the key elements contributing to the fertility of terra preta. The common absorption peaks are labeled a to d. These peaks have been previously identified through modeling [4]. None of the identified absorption peaks appeared in the spectrum of bamboo biochar. The unavailability of common absorption peaks between bamboo biochar and 2, 4-dinitrotoluene shows that bamboo biochar may not be rich in aromatic carbons, which then hints that bamboo biochar is not particularly good biochar for improvement of soil quality.

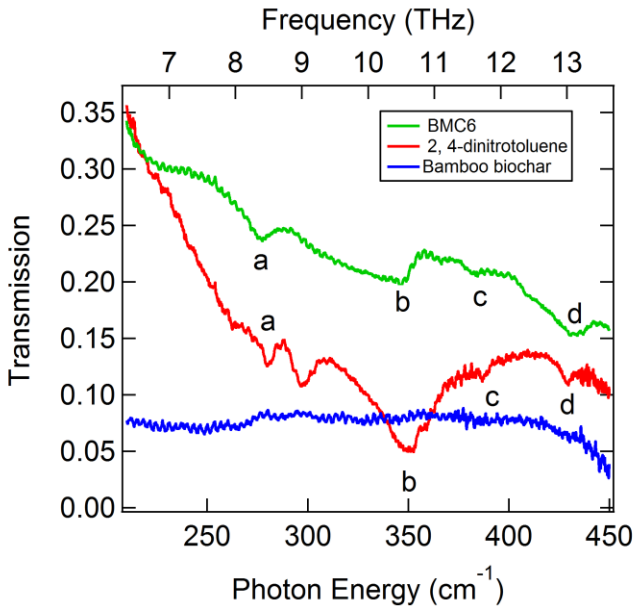

Figure 1: Room temperature THz transmission spectra of bamboo, BMC6 and 2, 4-dinitrotoluene.

III. SUMMARY

FTIR spectroscopy distinguished two kinds of biochar. Most of the absorption peaks in the good biochar (BMC 6) were attributed to aromatic compounds from the comparison with the spectrum of 2, 4-dinitrotoluene. This work has shown that terahertz spectroscopy is a good candidate for the characterization and identification of these materials.

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