RESEARCH PAPER | Chemistry | Volume : 3 | Issue : 3 | March 2013 | ISSN - 2249-555X

On the Nature of Laser Induced Fluorescence Spectrum of a Bore- Hole Sample of Coal

KEYWORDS: Laser induced fluorescence.

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ABSTRACT The present work describes the fluorescence spectrum of a sample of coal recovered from a depth of about 2km from the surface as a bore hole sample by Oil India Limited at Duliajan .The fluorescence spectrum was excited with the help of a 25mW green diode pumped solid state laser (532nm).The characteristic feature of the spectrum is a diffuse band in the region 6500-5900Å

Introduction:
Coal is a carbonaceous sedimentary origin, which occurs as an intimate mixture of organic and inorganic materials. The product of partial decomposition of living materials laid down in sediments on death makes coal very complex and it continues to be a subject of investigation during past several decades due to several reasons .One prominent among them is presumably the evolution of the planet earth itself .The fluorescence is one of the well known technique to indentify oil bearing rocks procured from deep inside the earth. The use of laser radiation as an excitation source has a major impact on the study of complex materials such as coal [1-4].A reasonably strong coherent monochromatic laser source can serve a variety of applications including sample induced fluorescence. Thus laser induced fluorescence (LIF) provides much as does Fourier transform infrared (FTIR) spectroscopy finger prints of different organic molecules which can be characterized by measuring fluorescence intensities. Many workers have described the microscopic fluorescence characteristics of various types of macerals .Liptinite maceral fluorescence more brightly then vitrinites,which in turn fluorescence more brightly than inertinites .The fluorescence intensity depends on the type of macerals ,rank and the degree of biochemical degradation in the peat swamp.

The present work is primarily concerned with the first qualitative interpretation of the fluorescence spectrum exhibited by a sample of coal obtained as a bore hole sample from OIL India with the application of a green diode pump solid state laser .The present finding has shown prime importance in characterizing or finger printing the structure of coal.

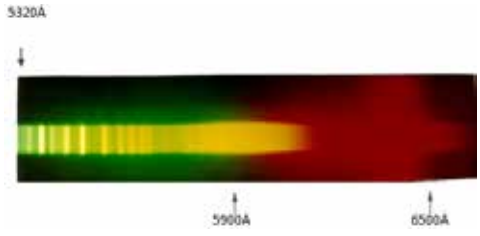
Experimental:
The coal sample was obtained as gift from OIL India , Duliajan. The sample is a bore hole sample procured by OIL and said to be originated from about 2 km deep from the surface. A diode pumped solid state green laser with power of 25mW and wavelength 532nm was used to excite the fluorescence of the coal sample. The finely powdered sample was made into a very thin pellet and the pellet was kept between two clean glass plates. The optical path of the sample thickness is 1nm.

It is worthwhile to note that the laser light was allowed to be incident on the sample and the fluorescence was observed in the same direction. This arrangement identical with the arrangement of stimulated Raman scattering. An exposure time of about 3 minute was adequate to photograph the fluorescence on a glass photograph using commercially available colour film. The intensity of the fluorescence spectrum was measured with the help of computer software known as Image-J. The fluorescence spectrum is shown below.

Results and discussion:
The fluorescence spectrum exhibits a broad and diffuse band in the red orange sectors (5900-6500 A) of the spectrum. This is a very narrow range of spectrum. The spectrum is similar to those reported in an earlier work [3]. The only difference is that the laser induced fluorescence spectra of some high sulphur Assam coals the fluorescence spectra were confirmed to a narrow range. The fluorescence spectrum in the red sector of the spectrum is mainly due to the presence of rich vitrinite portions in Assam coals [3]. Many authors have also reported the dark red fluorescence band for vitrinite in some coals. The vitrinite and liptinite group analysis of some coals [3] are shown table 1.

Table1- Physico chemical characteristics of some coal samples

Coal	Ash	moisture	Volatile matter	Fixed carbon	sulphur	Vitrinite vol.%
Ledo	10.35	3.07	43.38	43.20	3.57	78.65
Tikak	16.9	2.6	34.9	45.6	2.91	80.31
Tirap	6.6	1.8	45.4	46.2	3.20	79.88
Bargolai	5.7	2.4	47.4	44.5	5.30	78.25



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