Spectroscopic analysis of ablated producte for Nylon. 66

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Abstract:

A visible plume created by irradiating Nylon. 66 with excimer laser at 193 nm wavelength with a fluence greator than the ablation threshold was spectroscopicly analysed using a monocromator . The study of this plume spectrum allowing a preliminary identification of some of the major lumineseent species to be made . The spectrum shows that the most dominant band over the continum band being the CN and C2 bands.

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I. Introduction:-

Since at the start some difficulty in obtaining tissue samples was experienced, initial studies were conducted with Nylon 66 . The structure of this polymer has interesting similarities with the structure of fibres in the biological connective , in particular linkags NH-CO.

Nylon was first prepared (2) by Carothers in the 1930's latter on within few years it was produced commercially as fibers and textiles The name Nylon is a family name for a whole range of rasins which can be produced by condensing diamines with ditasic acids or by direct polymerization of amino acid to form long polymide chains. These chains consist of four to eleven methylene groups separated by an amine group. The number designation of Nylone shows the number of carbon atoms in material from which they were produced.(see the following example):

Nylon 6 - NH - (CH2)5 - CO2

Nylon 66 - NH - (CH2) NH - CO - (CH2)4 - CO-

Nylon 66 is prepared by the prolonged heating of amixture of adipic acid and hexamethylene diamine in an autoclvaen.

In This paper the spectra of aplume created by Excimer laser irradiating Nylon 66 will be discussed .

II. Experimental Setup :

Fig (1) shows the experimental apparataus which was used to study the visible UV emission spectram of plume . The target was placed in a cell which could be evacuted using a rotarry diffusion pump system to allow the effect of the pressure of the background gas to be investigated . The cell has three windows , two are for observation and the third for laser beam access to the target .The lens was mounted on translators which anabled the lens and target to move together so that the distance between them remain constant. Different regions of the plume could be imaged on to the monochromator slit using a 15 cm focal length quartz lens . A bentham instruments 300 mm scanning mononchromator equipped with an EMI 9814 quartz window photomuttiplier was used to aquire the spectrum , the output signal being integrated by a high input impedance amplifier . The output from the photomultiplier was plotted on the chert recorder as a function of ware length .

Result and Conclusions :

When Nylon 66 was irradiated at 193nm Argon Florid (ArF) excimer laser at fluence above threshold, a visible plume on the front surface of the target which is directed along the laser axis was observed (5,7) . Fig . (2) shows
a schematic drawing of the plume . The structure of the plume depends on the pressure of the cell which contains the target . Near the surface a hot jet of gas was observed , whereas further away from the surface this become like a ball . This implies that the fragments leave the target surface at high speed and after a short distance mix with the surrounding environment and combust with it (6,8) . Fig. (3) shows the spectrum of the ablation plume for Nylon 66 where L1 and L2 are the first and the second order of the laser wavelength . These were clearly identifiable , thus enabling accurate and simple calibration of spectrum .

The spectra of Nylon 66 at 5 torr of air is shown in Fig.(4). The most dominant band over the continum being CN band and C2 bands . These bands are maximised when the monochromator is moved away from the surface of the target by 3mm decresing as monochromator moved futher away . When the pressure in the cell was decreased (~ 0.01 torr) the spectrum of Nylon 66 was as shown in fig .(5) whereas the CN band can be identified . All bands die away as the

monochromator moves away from the surface . When a helium gas jet was directed onto the target the spectrum of the plume was as shown in fig . (6).

The continum was reduced more than for the higher pressure cases . It was concluded that most of the continum emission was due to electron impact excitation and electron recombination ,or emission from large species broad band (5,8) . The heluim or air served to cool the hot electrons by collisions leading to more efficient electron impact excitation .

References :

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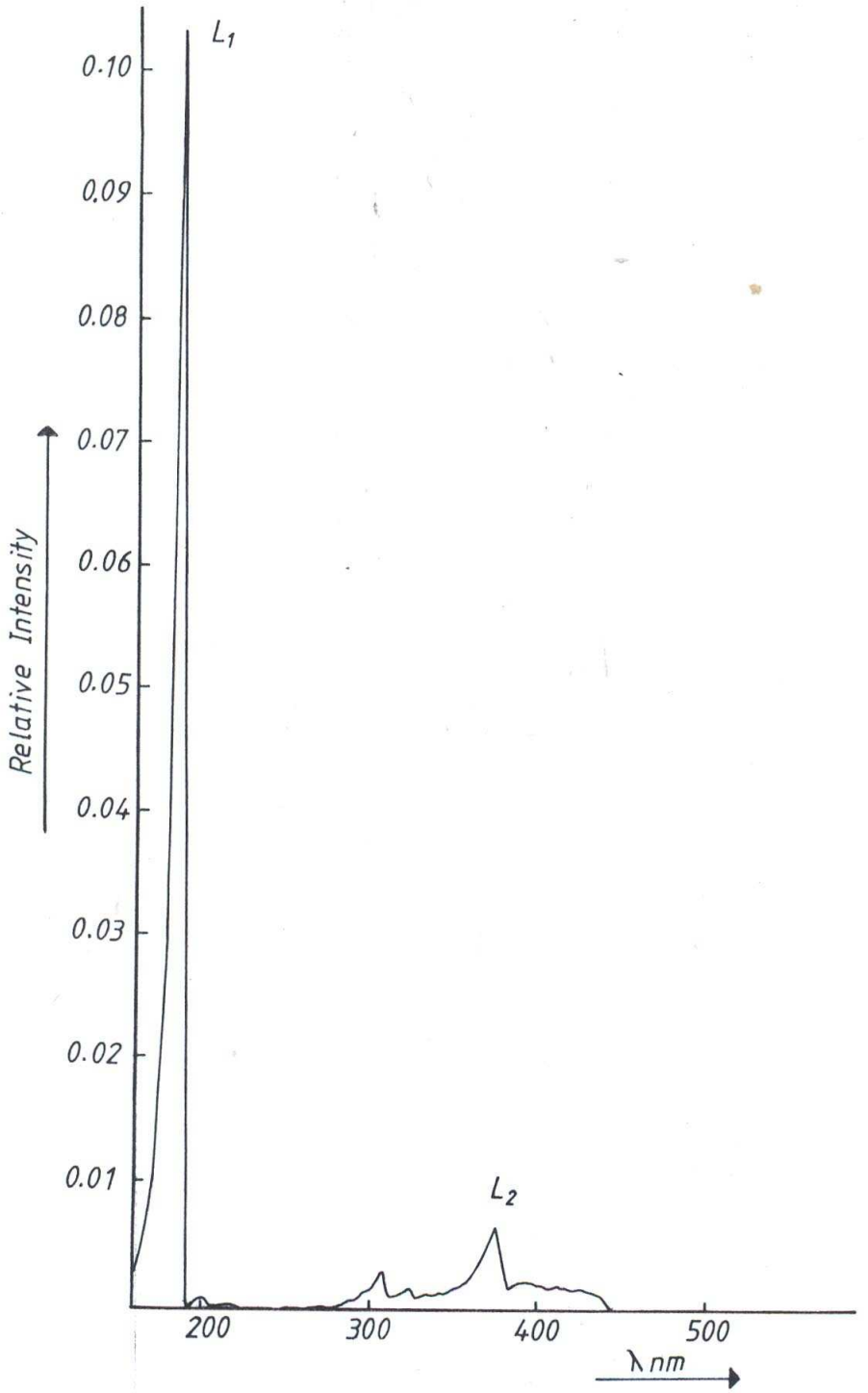

Fig. (3) The spectrum of Nylon 66 where the first and second order of ArF Laser clearly observed .

Figure 2 Experimental apparatus to study the plume.

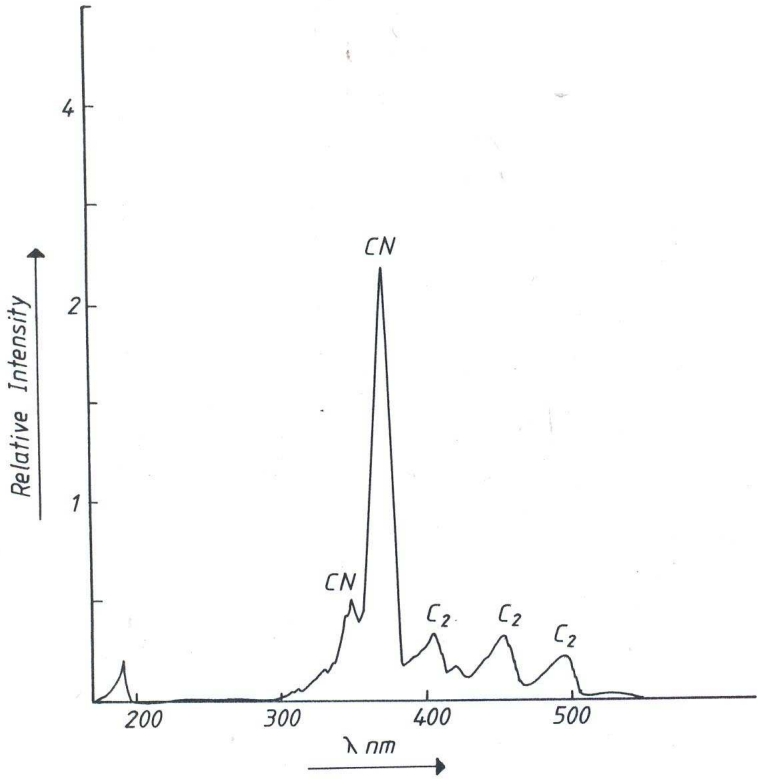

Fig. (4a) The spectrum of Nylon in 5 torr air environment, at 2mm away from the surface using ArF Laser(fluence 3.063 J/ cm²).

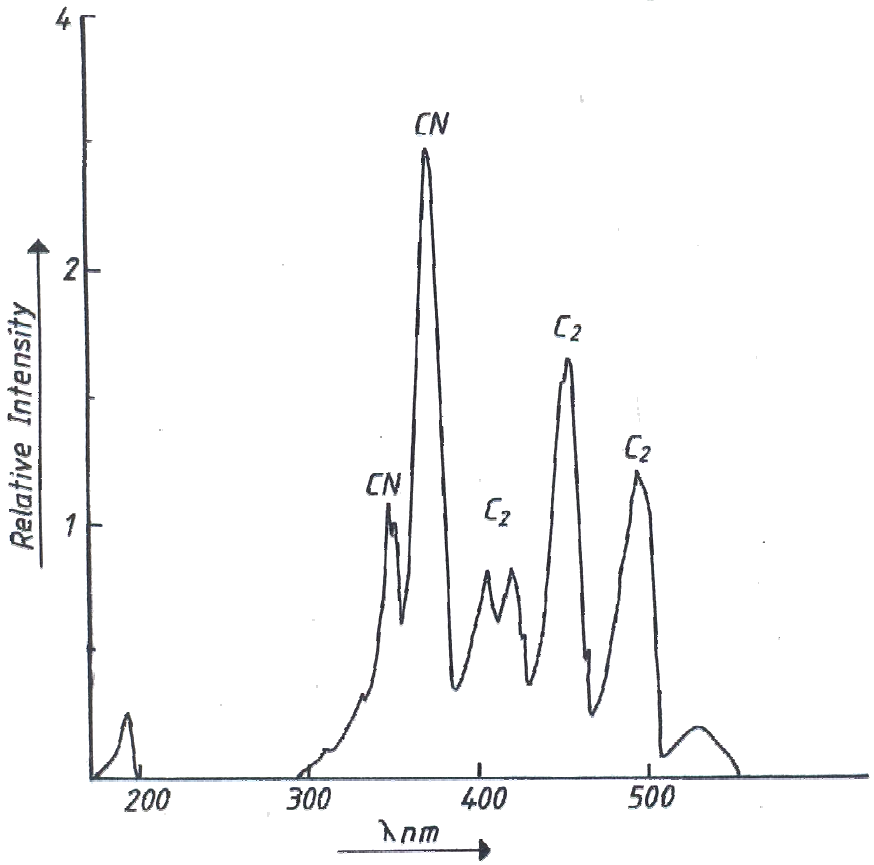

Fig.(4b) The spectrum of Nylon 66 in 5 torr air environment at 3mm away from the surface using ArF Laser (fluene 3.06 J/cm²).

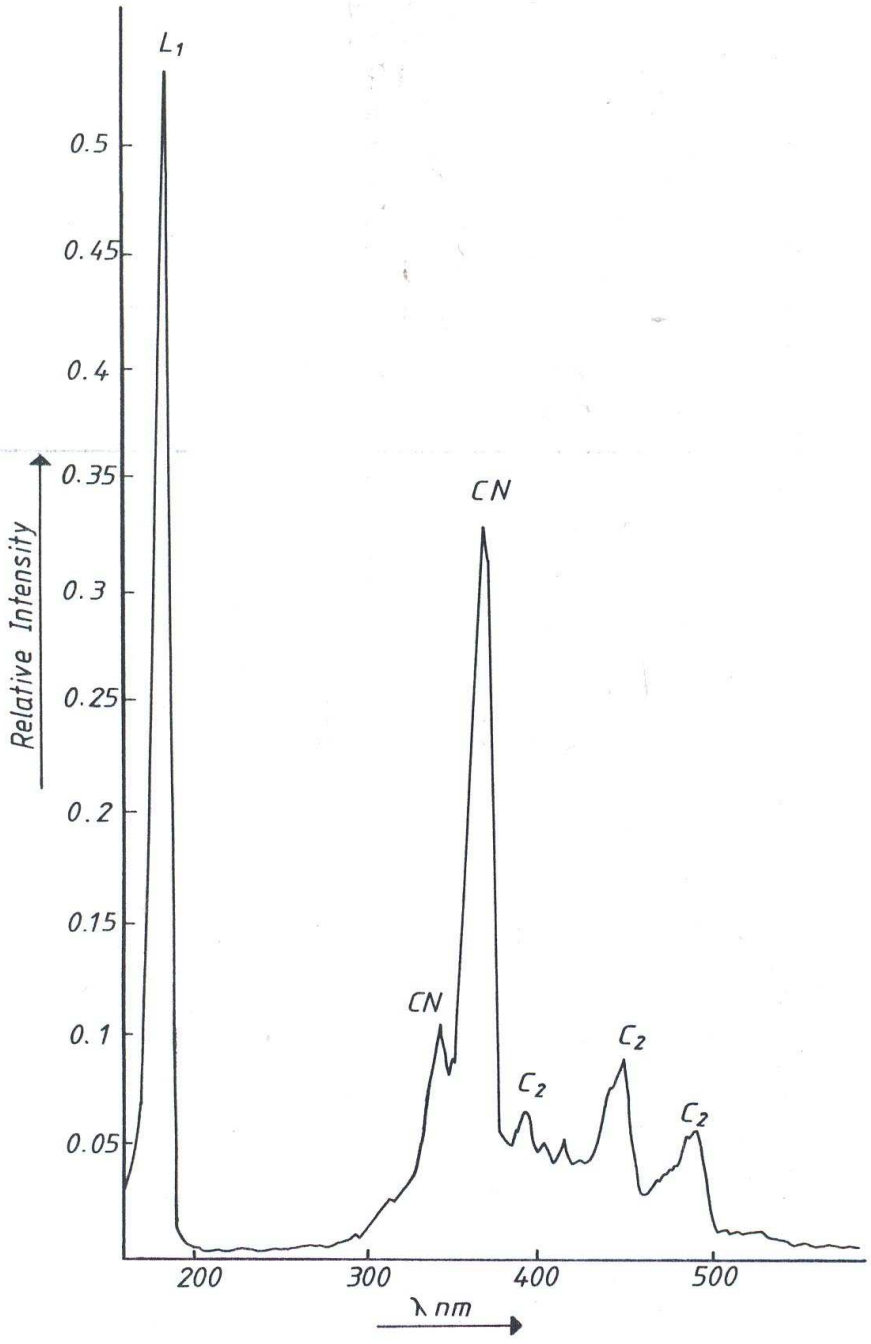

Fig.(6) The spectrum of Nylon 66 in 5 torr He gas environment 2 mm away from the surface using ArF laser (fluence 3.06 J/cm²).