POLYSACCHARIDES AS INTERSTELLAR GRAINS

Everyone accepts the fact that there should be some sort of solid particles present in interstellar space. However the precise nature and composition of this particle is still not very clear. One has to get its nature through indirect means. Obviously this will lead to multiplicity of possible models. One of the earliest model proposed is usually referred to as the dirty ice model. Then came the graphite model which was introduced to explain the observed feature at 2200 Å in the interstellar extinction curve. The extension of measurements into the infrared region showed the presence of two strong features around 10 and 20μ. Laboratory absorption measurements of a large number of rocks also show these two features. Hence this gave rise to the silicate model of the interstellar grain. From many of the sources, one also observes a feature at 3μ in addition to silicate features. This necessitated the interstellar grain to be a mixture of ice and silicate grains. Recently, Hoyle and Wickramasinghe (*Nature*, **268**, 610, 1977) have introduced another model based on polysaccharides. They point out that the detailed agreement between the silicate-ice model with the observed infrared spectra of a large number of galactic sources is not good. This lead them to the present model. Of all polysaccharides, cellulose has been studied extensively in the laboratory and the infarared spectra shows broad absorption both at 3 and 10μ. The absorption band at 3μ arises due to stretching of OH groups, while the broad absorption feature at 10μ may be due to stretching modes of C-O, C-O-C and to the C-H deformations within the cellulose molecules. Other polysaccharides also possesses these two absorption features with only minor variations. Using the laboratory measured transmission values for cellulose, they have calculated the emitted infrared fluxes as a function of wavelength for various infrared sources. The agreement between the calculated and the observed nature of the curves are very good. This seems to give a support for the identification of interstellar dust with polysaccharides. They appear to have dielectric constant of $n \simeq 1.5$ at visual wavelengths and seems to form fibrous whiskers. These could very well explain the observed extinction and polarization from interstellar space. The next question to ask is, how can one produce such a particle in interstellar space? The starting point for building process is formaldehyde (H_2CO), which is present in abundance in interstellar space. Formaldehyde has the property of polymerizing and this appears to be far more stable than simple formaldehyde. The authors try to show from known chemistry of these molecules that one can build stable polysaccharides from the chain process with substrates built from $(H_2CO)_6$ units. The most common form of polysaccharides are cellulose and starch which are very stable. Cellulose seems to maintain its structure upto $T \sim 600\text{-}800°$. Therefore they feel that grains of polysaccharides could easily be formed as a result of molecular evolution of gaseous formaldehyde under interstellar conditions.

In a more recent paper, Hoyle and Wickramasinghe (*M.N.R.A.S.*, 1977, in press) have applied their grain model for the infrared measurements of IR/OH maser source OH 26.5+0.6 of Forrest et al. (*Ap. J*, 1977, in press). The latter authors have obtained the spectrum of the source from 2 to 40μ by combining air and ground-based observations. The expected infrared fluxes based on optically thin grain model give a very good overall agreement with the observations. This, according to authors, lends further support to the hypothesis that polysaccharides form a major component of interstellar dust.

Based on the fit with the infrared observations, the new model seems to be quite convincing. If indeed polysaccharides are present in interstellar space, it shows the type of highly complex chemistry that one may be dealing with. However, the fact that polysaccharides are highly complex molecules should not discourage anyone on the face of it, of its acceptance, as large number of complex molecules have already been discovered in interstellar space. Hopefully, more work will be done in the next few years which will prove the validity of the model one way or the other.

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