Penn-54-4.

THERMAL CONDUCTIVITY STUDIES OF HIGH POLYMERS

FINAL

Final Report for Research Grant NsG 611

D. E. Kline, Principal Investigator

Initial funding for NASA Research Grant NsG 611 provided for the period 1 April 1964 to 31 March 1966. A request was made in January 1966 to have the grant termination date extended from 31 March 1966 to 31 December 1966 without additional funding. This request was granted.

Research Grant NsG 611 has been instrumental in significantly furthering thermal conductivity studies in polymers. In addition, through radiation studies of polytetrafluoroethylene (PTFE), it has been largely responsible for leading to the discovery of two significant radiation effects in PTFE:

1. Whereas no differences in the effects of gamma irradiation as compared to reactor radiation (neutron and gamma) have previously been detected in polymers, a significant difference has been detected in radiation studies of PTFE[2].
2. Contrary to previous observations for other polymers, the percentage crystallinity of PTFE as measured by infrared increases, rather than decreases, with gamma radiation doses in the approximate dose range 9-900 megarads.[3]

The thermal conductivity of various polymer systems has been studied and analyzed under the current grant. Several of these systems have been altered by nuclear radiation to study radiation effects as well. It is noteworthy that radiation has been found to be a very effective tool for

altering the internal structure and thus helping to ascertain the effects of changes in percent crystallinity, addition of molecular crosslinks, etc. in changing the thermal conductivity of polymers.

Up to the present time, three research papers have been prepared and accepted for publication[1,2,3] based upon research which was wholly or in part supported by Research Grant NsG 611. A fourth paper is in preparation and nearing completion[4]. Further thermal conductivity studies are currently underway, but these will not be completed before this report is issued. Following analysis of results from current investigations it is probable that other research papers will be prepared for publication.

Although it was originally anticipated that a study of the thermal conductivity of linear and branched polyethylene (PE) would be conducted as part of the grant, this work was essentially completed before the grant was received. A paper has been published on the results of this investigation[5].

Five graduate students carrying out thesis research under the supervision of D. E. Kline have received support from Research Grant NsG 611 in the form of a stipend and/or supplies and materials*. Four of these have received their graduate degrees and the fifth student is currently completing his thesis requirements. It is estimated that he will receive his Ph.D. in June 1967.

In early 1966, D. E. Kline was asked to prepare a chapter entitled, "Thermal Conductivity of Polymers" for a book in the series Polymer Thermal Analysis[6]. Professor D. Hansen of the Rensselaer Polytechnic Institute has agreed to be co-author. The chapter is scheduled to be completed by 1 July 1967. Until the termination date, the Research Grant NsG 611 contributed materially to the preparation of this chapter.

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* Some of the students arranged for their own stipend support.

The assistance of the Polymer Chemistry Section of the National Bureau of Standards and the interest of Drs. Wall and Florin in carrying out the radiation studies is gratefully acknowledged. The author is also indebted to Mr. M. S. Parker of NBS for assistance in irradiations.

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6. D. Hansen and D. E. Kline, "Thermal Conductivity of Polymers", Chapter of Polymer Thermal Analysis, Volume II, Marcel Dekker, Inc. (To be published).