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Book Review

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Book Review

ADHESION OF SOLIDS, by B. V. Deryagin, N. A. Krotova and V. P. Smilga (translated by R. K. Johnston). Consultants Bureau, div. Plenum Publishing Co., New York, 1978. 457 pp. (\$49.50)

This book is essentially a summary of the research on adhesion between solid bodies which has been carried on by the senior author and his collaborators over a period spanning almost a half-century. As such, it is a monument to Professor Deryagin's breadth of interests and to the energy with which he has attacked some of the most difficult problems in the field. It is not a balanced review of the development or current status of research on adhesion phenomena. Work performed outside of the USSR is mentioned only occasionally and certain topics of considerable importance (such as the relation of polymer rheology and fracture mechanics to bond strength) are almost completely neglected.

The major subjects discussed include: the role of electrostatic forces in adhesion phenomena and related manifestations such as electron emission during fracture, the theory of electrical double layer formation at boundaries between solids (especially with regard to semiconductors), the influence of interdiffusion on bonding between polymers, adhesion effects involving convex solid bodies and powders, and the relation between friction and adhesion. An appendix contains descriptions of a wide variety of "adhesiometers" used in this work, which are now of mainly historical interest, exemplifying the heroic measures required before the advent of modern instrumentation.

The unifying theme of this exposition is the authors' view that most adhesion phenomena are best interpreted in terms of attractive forces between double layers of electric charges, which are formed when dissimilar materials are placed in close contact. This mechanism is not expected to prevail in all situations; two others which are discussed in detail are "autohesion" due to interdiffusion of polymer chains (commonly associated with Voyutskii and his collaborators) and capillary effects due to the presence of a fluid layer at the interface (generalizations of Stefan's Law). Nevertheless, one can scarcely avoid feeling that the authors habitually choose the electrostatic double layer

approach to explain almost any new phenomenon. This is not the place to reopen the debate over the merits of the electrostatic theory of adhesion, but it must be stated that the hypothesis is not critically examined in this volume. The authors rather show how it may be used to interpret various types of experimental results, with little consideration of possible alternative explanations.

Considered as a whole, this very extensive body of work displays a surprising degree of separation between theory and experiment. Lengthy and complex calculations are performed in order to derive theoretical expressions for the electrostatic adhesion between dielectrics and semiconductors, or the influence of the electric double layer on rolling friction, for example, and the subject is then dropped with little or no experimental verification of the predictions based on the chosen model. Similarly, complicated and difficult experiments are performed (such as those dealing with the adhesion of powders) and a few results are quoted (generally with no indication of experimental precision), together with the statement that they are consistent with the electrostatic theory of adhesion. (In some cases, such as the adhesion of polymer films to germanium (p. 220) or the shear strength of bonds between different rubbers (pp. 270–274), the agreement between the data and the proposed model seems tenuous at best.)

The translator appears to have made a commendable effort to ensure maximum clarity and readability, and the text contains relatively few obvious errors or misprints. There are, however, several graphs with unlabeled axes, and at least two sets of data (on pp. 63 and 242) which appear to have little relation to the discussion they are supposed to illustrate. For the reader without easy access to the original publications, there are a disconcerting number of instances in which important details have been omitted from the summarized data or derivations.

To whom, then, can this book be recommended? Certainly not to beginners in the field, or to those who seek a critical survey of its current status. The discussion of practical matters (adhesion testing, surface preparation, etc.) is also largely out of date or superficial. On the other hand, many of the authors' viewpoints should not be casually dismissed without deeper consideration; some of the questions they have raised may well merit further and more critical investigation. Readers who desire a second opinion (with which this reviewer cannot wholly agree) may wish to consult the review of the original Russian edition.†

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† J. J. Bikerman, *J. Adhesion* 7, 158 (1975).