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Andrade J D. Interfacial phenomena and biomaterials.
Med. Instrum. 7:110-20, 1973.
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This paper reviewed basic surface and interface science and applied it to the question of the "biocompatibility" of synthetic materials used in medical devices. It formulated the minimum interfacial free energy hypothesis and developed the relationship and correlations between more commonly known surface parameters and the interfacial free energy between polymers and aqueous solutions. [The *SCI*® indicates that this paper has been cited in over 80 publications since 1973, making it the most-cited paper published in this journal.]

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This paper was my first serious effort at attempting to apply the basic principles of surface and interface science to the questions and problems in the implant biomaterials field.

D.J. Lyman, University of Utah, had been invited to present a paper at the Seventh Annual Meeting of the Association for the Advancement of Medical Instrumentation in Las Vegas in April 1972. He couldn't accept and suggested that I give the paper. I jumped at the chance, and the organizers of the meeting kindly agreed to let a young, unknown assistant professor give an "invited" talk. I remember the meeting well. Others on the program included Larry Hench, John Autian, and Vincent Gott, all well-known biomaterials scientists.

The fact that the paper has been modestly cited is perhaps because it was the first comprehensive review and presentation of basic surface-science principles applied to protein adsorption, cell adhesion, tissue reaction, and general "biocompatibility." It is, frankly, still a reasonably good introduction to the subject.

The major scientific contribution of the paper was the formulation of the minimum interfacial free energy hypothesis. This is a very simple concept and argues that, as the interfacial free energy between two phases goes to zero, interfacial processes are minimized. Basically, one attempts to "eliminate" the interface. Highly water-swollen aqueous gels were being considered for medical device applications, and the hypothesis provided a rational means to study and interpret their interfacial behavior.

The concept was generated about five years earlier in stimulating discussions with Paul Predecki, professor of materials science at the University of Denver, Colorado. Paul was my PhD thesis supervisor and was very instrumental in formulating the early ideas. So was Leo Vroman (Brooklyn VA Hospital), who was a consultant to our NIH contract on coagulation-resistant surfaces. In fact, it was Vroman's delightful book, *Blood*,[1] (which my wife, Barbara, and I literally stumbled across in a rustic and cozy Denver public library in 1967) that really stimulated my interest in blood-materials interactions.

The major problem with the interfacial free energy hypothesis is the measurement. Although we and others have struggled with this problem over the years, the measurement of solid-liquid interfacial free energies is still very unsatisfactory.

Our group is now attempting to understand surface motions and dynamics in the hopes of more completely assessing the role of interfacial free energies in polymer-biological solution processes and particularly in protein adsorption. Our more recent thoughts on this and related areas are included in two recent books.[2,3]

1 **Vroman L.** *Blood* Garden City, NY Natural History Press, 1967 178 p
2 **Andrade J D,** ed *Surface and interfacial aspects of biomedical polymers* New York Plenum, 1985 470 p
3 ----------, ed *Protein adsorption* New York Plenum 1985 345 p

