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J. N. van Niekerk
F. R. L. Schoening

National Physical Laboratory,
Council for Scientific and Industrial Research,
Pretoria.
Aug. 18.

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Surface Free-Energy of Solid Paraffin Wax

As part of a programme of research on the surface free-energy of solids, we have lately been working on paraffin wax. The method used is the one proposed by Bergren[1] and consists in measuring the rates of elongation or contraction of thin filaments of different lengths hanging under their own weights. The change in length results from two opposing forces: one which tends to shorten the filament so that its surface free-energy is decreased, and the other tending to lengthen the filament because of its weight. A critical filament-length, l_0, is determined at which the elongation of the upper part of the filament is equal to the contraction of the lower part, so that the length remains constant. Assuming that the solid near the melting point behaves as a viscous liquid, that is, the rate of deformation is proportional to the applied stress, the surface free-energy of the solid can be calculated from the critical length l_0 using the equation:

$$\gamma = \tfrac{1}{2}\rho g r l_0,$$

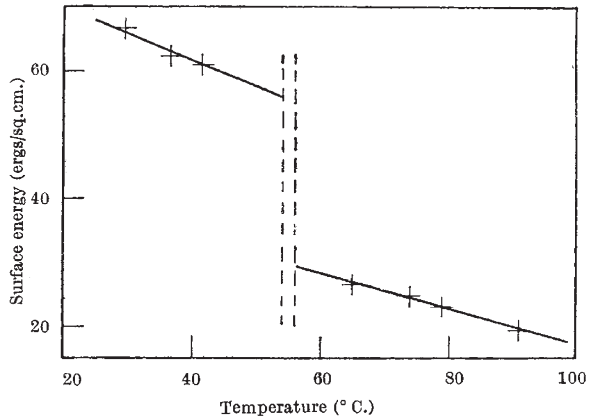
where γ is surface free-energy, ρ is density of solid at temperature of experiment, g is acceleration due to gravity, and r is radius of wire.

In our experiments, filaments of 0·01088 cm. radius were produced by extrusion of the paraffin wax (melting range 54–56° C.) through a tungsten carbide die at room temperature into a constant temperature ($\pm$ 0·1° C.) enclosure. The observations were then made on the filament hanging from the die. The change in length was measured at intervals by means of a cathetometer, and $\Delta l/l\Delta t$ (positive or negative) plotted against the original length of the filament. This should be a straight line according to theory, and l_0 was obtained by interpolation as intercept on the length axis.

Measurements were carried out at 29·5°, 36·7° and 41·5° C., and the surface free-energy calculated using $\rho_{20^{\circ}\mathrm{C.}}$ = 0·8857 gm./cm.³, the change in density being negligible over the temperature-range concerned. The results are plotted in the accompanying graph, together with values for the same specimen of paraffin wax in the liquid state determined by the ring tensiometer method and corrected by the method of Harkins and Jordan[2].

The results indicate a discontinuity in the surface free-energy on melting. On the other hand, the temperature coefficient of the surface free-energy does not alter appreciably.

The same method has been used for measuring the surface free-energy of tin (99·99 per cent pure) *in vacuo* at 215° C. (17° below melting point). Polycrystalline wires with transverse grain boundaries



Surface free-energy of solid and liquid paraffin wax

(1/25 cm. average longitudinal grain-size) were extruded from the electrically heated die directly into the evacuated constant-temperature chamber. After correcting for the grain boundary energy according to Udin[3], the surface free-energy at 215° C. was found to be 685 ergs/cm.².

Further work on the surface free-energy of tin and other low-melting metals at different temperatures is in progress. A detailed account of this will be published later.

E. B. Greenhill

Division of Tribophysics,
Commonwealth Scientific and
Industrial Research Organization,
University of Melbourne.

S. R. McDonald

Chemistry Department,
University of Melbourne.
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A Device for Counting Small Particles suspended in a Fluid through a Tube

Attempts to count small particles suspended in fluid flowing through a tube have not hitherto been very successful. With particles such as red blood cells the experimenter must choose between a wide tube which allows particles to pass two or more abreast across a particular section, or a narrow tube which makes microscopical observation of the contents of the tube difficult due to the different refractive indices of the tube and the suspending fluid. In addition, narrow tubes tend to block easily.

These difficulties can be overcome by slowly injecting a suspension of the particles into a faster stream of fluid flowing in the same direction. Provided there is no turbulence, the wide column of particles will then be accelerated to form a narrow column surrounded by fluid of the same refractive index, which in turn is enclosed in a tube which will not interfere with observation of its axial contents.

This principle has been applied to the alignment of red blood cells preparatory to electronic counting. The constructional details of the apparatus in use are shown in the diagram.