
 COMMENTS

Equation of State of a Two-Dimensional Gas of Pentadecanoic Acid*

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We report surface pressure measurements for a two-dimensional system composed of pentadecanoic acid spread on a water substrate of pH 2. We observe mean-field exponents in agreement with the findings of Hawkins and Benedek obtained on pure distilled water, but we find it impossible to interpret all of our results in terms of a mean-field phase transition. The observed compressibilities are as much as a factor 20 times larger than theirs.

In a recent Letter¹ Hawkins and Benedek presented the results of measurements of the surface pressure exerted by a monomolecular layer of pentadecanoic acid, $\text{CH}_3(\text{CH}_2)_{13}\text{COOH}$, spread on a distilled water substrate. They found that this system has a true gas-liquid coexistence curve, as was surmised by Adam and Jessop² in 1926. In addition they measured the isothermal compressibility of the monolayer along the liquid side of the coexistence curve, $(K_T)_l$, and found it to vary as $(\rho_l - \rho_v)^{-2.0 \pm 0.3}$, where ρ_l and ρ_v are the densities of the coexisting liquid and vapor phases, respectively. This behavior is expected for a system approaching a phase transition describable by mean-field theory.

We have been independently engaged in making similar measurements for several years using the same substance spread on a water substrate of pH 2 and obtain results which differ from theirs in some respects. A detailed account of this research will be published separately.³ Our results do confirm their finding that this system has a true coexistence curve. In fact we find that at any given temperature the pressures of the vapor and liquid phases at the coexistence curve are equal to within ± 0.02 mdyn/cm which is the limit of our accuracy. We also find $(K_T)_l \propto (\rho_l - \rho_v)^{-2.01 \pm 0.13}$ in agreement with their result. However, for a given value of $\rho_l - \rho_v$ our values of $(K_T)_l$ are as much as 20 times greater than theirs, and the actual measured surface pressures differ by as much as a factor of 2. One possible reason for these differences will be discussed below.

In addition to measuring $(K_T)_l$ as a function of $\rho_l - \rho_v$ we have measured K_T in the vapor phase, $(K_T)_v$, and at the inflection points of the isotherms above the critical temperature, $(K_T)_{T > T_C}$. We have also measured the width of the coexistence curve, $\rho_l - \rho_v$, as a function of temperature. In the vapor phase we find $(K_T)_v \propto (\rho_l - \rho_v)^{-1.94 \pm 0.11}$, in agreement with the behavior in the liquid phase.

Although a direct determination of the critical temperature, T_C , was not possible we find that for a narrow range of choices for T_C , all of the quantities measured exhibit power-law behavior and the exponents are in excellent agreement with mean-field theory. The results of this analysis are given by

$$(K_T)_v = 2.73 \times 10^3 (T_C - T)^{-0.97 \pm 0.04} \text{ cm/dyn,}$$

$$(K_T)_l = 1.25 \times 10^3 (T_C - T)^{-0.98 \pm 0.07} \text{ cm/dyn,}$$

$$(K_T)_{T > T_C} = 6.73 \times 10^2 (T - T_C)^{-0.98 \pm 0.03} \text{ cm/dyn,}$$

$$\rho_l - \rho_v = 41.9 (T_C - T)^{0.50 \pm 0.03} \text{ molecules}/10^4 \text{ \AA}^2.$$

The finding that $(K_T)_v \simeq 2(K_T)_l \simeq 4(K_T)_{T > T_C}$ does not agree with the mean-field prediction $(K_T)_v \simeq (K_T)_l \simeq \frac{1}{2}(K_T)_{T > T_C}$. This disagreement can not be removed by any reasonable choice of T_C .

Our experiment differs from that of Hawkins and Benedek primarily with regard to surface cleanliness and substrate pH control. We feel that the latter factor is the most relevant one. We have observed that when using pure freshly distilled water with no pH control, we obtain results fairly near our own, but that after the water has been stored for ~ 12 h we obtain coexistence

pressures in reasonable agreement with theirs. We speculate that this change could be caused by loss of CO_2 present in the freshly distilled water which would tend to make it slightly acidic initially. As the $p\text{H}$ increased, pentadecanoic acid would dissociate and react with positive ions such as Ca^{++} present in the substrate, and the additional mass would tend to decrease the coexistence pressures.

We are extremely grateful to Dr. N. L. Gershfeld for advice and encouragement during the long process of producing a "clean" substrate. We would like to thank Professor G. B. Benedek

and Dr. G. A. Hawkins for discussing many aspects of their experiment with us and for providing us with a copy of Dr. Hawkins's thesis.

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¹G. A. Hawkins and G. B. Benedek, *Phys. Rev. Lett.* **32**, 524 (1974).

²N. K. Adam and G. Jessop, *Proc. Roy. Soc., London, Ser. A* **110**, 423 (1926).

³M. W. Kim and D. S. Cannell, to be published.

ERRATUM

SEARCH FOR GRAVITATIONAL RADIATION AT 145 Hz. Hiromasa Hirakawa and Kazumichi Narihara [*Phys. Rev. Lett.* **35**, 330 (1975)].

On page 331, column 2, line 18 from the bottom, "The support yields a negligible (unloaded $Q_M \simeq 2.0 \times 10^5$) and a minimal amount of coupling . . ." should read "The support yields a negligible loss (unloaded $Q_M \simeq 2.0 \times 10^5$) and a minimal amount of coupling"

INHOMOGENEOUS BROADENING AND EXCITED-VIBRATIONAL-STATE LIFETIMES IN LOW-TEMPERATURE ORGANIC MIXED CRYSTALS. A. P. Marchetti, W. C. McColgin, and J. H. Eberly [*Phys. Rev. Lett.* **35**, 387 (1975)].

The wavelengths in the fourth paragraph should read 5921.7 Å (O_1), 5920.1 Å (O_2), 5878.7 Å (O_3), and 5858.4 Å (O_4). In the third line of the ninth paragraph $\Delta\nu_1^*$ should be substituted for $\Delta\nu$.

ELECTROMAGNETIC ION-BEAM INSTABILITIES IN THE SOLAR WIND. Michael D. Montgomery, S. Peter Gary, D. W. Forslund, and W. C. Feldman [*Phys. Rev. Lett.* **35**, 667 (1975)].

Through an oversight, the footnote "Permanent address: Physics Department, College of William and Mary, Williamsburg, Va. 23185" was omitted from the name of S. Peter Gary on our manuscript.