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Step-Step Interactions on TaC(910)[1]

J.-K Zuo,[a,b] *T.-J. Zhang,*[a,c] *J. F. Wendelken,*[a] *Z. Zhang,*[a] *and D. M. Zehner*[a]
[a] Solid State Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831
[b] Department of Physics, Southwest Missouri State University, Springfield, MO 65804
[c] Department of Physics, The University of Tennessee, Knoxville, TN 37996

TaC, an ionic crystal with an extremely high melting point of ~3983 C, exhibits a strong faceting behavior for (n10) surfaces after heating to ~2000 C.[2] These facets are very regular when n = 1,2 or 3 but become less regular when n = 9. Through a scanning tunneling microscopy based study of the step distribution and structure on TaC(910), we determine that the observed morphology results from the interplay of a step-step repulsive interaction with both short- and long-range attractive interactions. The surface is dominated by bunched double-height steps where the bunches are separated by relatively long intervening (100) terraces having irregular widths. The step-separation distribution is highly skewed and sharply peaked at 13 atomic rows, the average spacing within a step bunch, while the (910) orientation is maintained with an average step-separation of about 18 rows. A Monte Carlo simulation shows that a weak, long-range, attractive interaction, $-B/x^{\alpha}$, must be added to a strong, medium-range, repulsive interaction, A/x^2, to fit the measured distribution. In addition, a short range attractive interaction is required for the creation of multiple-height steps that are oriented in the [010] direction. Possible physical origins for each of these interactions will be discussed.

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[2] J.-K. Zuo, J. M. Carpinnelli, D. M. Zehner and J. F. Wendelken, *Phys. Rev.* **53**, 16013 (1996).

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