Scientific Memos

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1 The Binding Energy Scales as $1/N$

By definition, the binding energy $B(N, N_e) \equiv E(N, N_e + 2) + E(N, N_e) - 2E(N, N_e - 1)$, where N_e is the number of electrons and N the number of atoms. Because the energy has to be extensive, we have $E(N, N_e) = N e(N_e/N)$, where e is an intensive function. Therefore,

$$E(N, N_e + 2) = N e(N_e/N + 2/N) = N \left[e(n_0) + \frac{2}{N} e'(n_0) + \left(\frac{2}{N} \right)^2 e''(n_0)/2 + \cdots \right], \tag{1}$$

where $n_0 \equiv N_e/N$. Finally $\boxed{B(N, N_e) = e''(n_0)/N.}$