BE-PEC model in effect says that the exciton which is recombining is not the exciton in the BE but rather one of the excitons in the PEC. It is difficult to see why this process should have the same stress and Zeeman-splitting behavior as an isolated BE. It is also worth noting that no evidence of PEC in Si has been reported, and that although the biexciton binding energy has been calculated to be 0.5 meV,[15] I see BMEC lines at temperatures above 15 K.

In conclusion, my results support the "simple" BMEC model, although it is obvious that even very approximate theoretical treatments of this model will be far from simple.

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COMMENTS

Comment on "Spin-Polarized Photoelectrons from Nickel Single Crystals"

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New measurements of the spin polarization of photoelectrons from nickel single crystals are shown to be compatible with a simple band-theory interpretation. The value of the gap Δ between the + spin Fermi energy and the top of the d band is estimated from the data to be about 75 meV, in good agreement with other estimates.

In a recent Letter, Eib and Alvarado[1] measured the spin polarization P of photoelectrons from the (100) face of a single crystal of nickel. The polarization was found to be negative when the quantity ϵ = photon energy − work function was less than about 100 meV, to change sign at about this value of ϵ, to reach a maximum at ϵ about 650 meV, and then to decrease at higher photon energies. The lowest and highest values of the spin polarization were about $\mp$ 30%, respectively, although the value of this negative polarization is not claimed to be very accurate. The main emphasis was to be placed on the negative polarization at low ϵ and not on an accurate value thereof.

These results differ from those obtained earlier[2] for polycrystalline specimens for which P was found to be always positive. This earlier finding was claimed to be a key result in understanding the ferromagnetism of transition metals.[3] The new results are now stated[1] to be compatible with the old ones since the latter arise from inhomogeneities of the work function of polycrystalline specimens. The new results are still claimed to form a potential basis of understanding the ferromagnetism of transition metals. However, they are also claimed to exclude an interpretation based on a simple band theory such as that given by Wohlfarth.[4] The reason for this exclusion seems to be that the data would then demand an exchange splitting less than 300 meV. If a simple band-theory interpretation of these data is excluded, the new results would continue to imply that the many-body effects of the genre of Edwards and Hertz[5] and others are important.

The aim of this Comment is to welcome these new results as doing precisely what the authors disclaim, namely to confirm even semiquantitatively the simple band-theory interpretation of the photoemission data.[4] This discussion of Ref. 4 relied on a simple rectangular model density-of-states curve which encompasses schematically the features of some reliable band calculations. The key feature is the energy gap Δ between the + spin Fermi energy and the top of the d band where the single-particle density of states rises rapidly. Thus a curve was obtained relating P with ϵ/Δ for dimensions of this schematic density-of-states curve compatible with the actual band calculations. It is shown in Fig. 1 that the

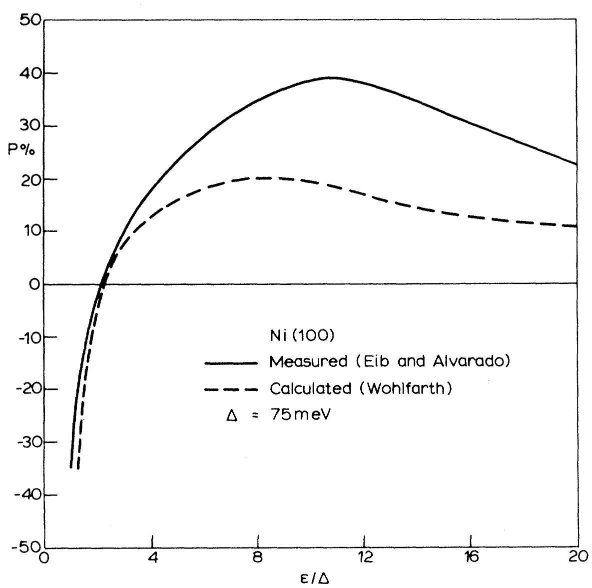

FIG. 1. Measured (Ref. 1) and calculated (Ref. 4) curves of the photoemission spin polarization P from the (100) face of a nickel single crystal as a function of the reduced energy ϵ/Δ for a value of the energy gap Δ =75 meV.

observed curve[1] can be fitted as well as can be expected over the range of the calculated curve[4] (ϵ/Δ up to 20) with a value of the gap Δ about 75 meV. That which was suggested in Ref. 4 has thus come to pass in that measurements at different ϵ give an approximate estimate of Δ. The exchange splitting compatible with these results is about 500 meV. This agrees with some, but not all, estimates of this splitting but is certainly above the 300 meV given in Ref. 1; this last value must have been due to a misunderstanding.

This estimated Δ cannot be regarded as a very accurate value. There is a sizable difference in polarization at the higher energies. This may be partly due to the simplicity of the rectangular band shape assumed; a more realistic band may give better agreement. The photoemission process is, in addition, much more complicated than is implied by the use of a simple density-of-states curve. The aim of the original calculation[4] was, however, solely to obtain a polarization curve based on the simplest assumptions possible. It is thus surprising how well this Δ agrees with other estimates, as follows: (1) A magnetization-temperature curve of nickel gives for the low-temperature correction to the spin-wave contribution a term implying[6] $\Delta = 40$ meV. (2) The spin-wave dispersion curves of nickel enter the Stoner continuum at energies[7,8] 100, 95, and 75 meV in the [100], [110], and [111] directions, respectively, so that $\Delta \lesssim 75$ meV. (3) Optical data[9] have been interpreted with $\Delta \simeq 50$ meV as the minimum value and $\Delta \simeq 83$ meV as an average value of the gap.

The agreement with the present estimate is thus good and it should be concluded that the new photoemission data can indeed be interpreted on the basis of a simple band theory. The small value of the gap, if unsupported by future band calculations, may after all be partly a manifestation of electron-magnon interactions.[15] It is suggested in Ref. 1 that the temperature dependence of the electron spin polarization would be interesting to consider. Theoretical curves on the present basis have already been obtained by Donà dalle Rose.[10]

When discussing the present controversy, in the past it has been customary to mention a number of other matters. Two of these concern an observation of magnetic effects above the Curie temperature[8] and tunneling experiments.[11] As to the first of these no claim is made here that *these* effects are compatible with the simple band theory.[12] A new model[13] of the behavior of nickel at and above the Curie point allows the persistence of spin waves, in agreement with the neutron data.[8] The tunneling experiments, on the other hand, should never be discussed in the same breath as the photoemission experiments. As was pointed out in Ref. 4, the electrons concerned in the two effects are essentially different. The same applies for field emission where Politzer and Cutler[14] showed that the emission from a (100) face of nickel is largely due to the *s*-*p* electrons.

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