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Electrical Detection of Mechanical Resonance of ZnO Nanowhiskers DEEPIKA SAINI, DOYL DICKEL[1], RAMAKRISHNA PODILA, HERBERT BEHLOW, MALCOLM SKOVE, APPARAO RAO, Clemson University — Here, we present the fundamental mechanism for the observation of electrically actuated resonances in semi-conducting ZnO nanowhiskers (NWs). Previous studies have claimed that various mechanisms including charge induction lead to a mechanical resonance in NWs. Many of such studies employ an electron beam to visualize the resonance of NWs. However, we find that the use of an electron beam changes the electrical character of the NWs making it difficult to understand fundamental actuation mechanism. In this article, we developed a novel, fully electrical harmonic detection of resonance (HDR) method that enables us to probe mechanical resonances of NWs even in the absence of an electron beam. In contrast to the traditional optical detection scheme, the HDR method allows us to successfully decouple the effects of the electron probe beam from the actual driving force. Interestingly, we find that the observed mechanical resonance of ZnO NWs is dominated by their interactions with the electron probe beam. Importantly, ZnO NWs exhibit strong (weak) mechanical resonance only in presence (absence) of the electron probe beam suggesting that the observed behavior originates from dynamically induced (static) charges.

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