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Self-heating in an AlGaN/GaN transistor studied by ultraviolet and visible micro-Raman scattering MOHAMMAD NAZARI, LOGAN HANCOCK, EDWIN PINER, MARK HOLTZ, Texas State University — The two-dimensional electron gas (2DEG) at GaN/AlGaN interface is the basis for high electron mobility transistor. The 2DEG region forms spontaneously without any doping and is less than 10 nm in thickness. Current-induced self-heating results in large temperature rises in these devices and represents the principal limiting factor in these devices. We report direct measurements of self-heating in an AlGaN/GaN high electron mobility transistor using ultraviolet (UV) and visible micro-Raman spectroscopy. The phonon shift is used to evaluate operando temperature rise in different layers of the material stack corresponding to different depths. UV measurements, due to short optical penetration depth, give temperature rise in top 100 nm of GaN, i.e., close to the 2DEG. The visible measurements provide an average temperature rise through the 1 micron thick GaN layer and in the Si substrate close to the interface. A depth profile is developed based on the combined data sets obtained under experimentally identical conditions. Finite element thermal simulation developed based on the experimentally determined temperature-depth profile reveal thermal resistance barrier of 10^{-8} K·m^2/W at the interface between AlN and Si substrate.

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