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Identification of chemical environment of defects in ZnO by means of digital coincidence Doppler broadening of positron annihilation spectroscopy. PETR STEPANOV, Department of Physics and Astronomy, Bowling Green State University, Bowling Green, OH, 43403 — The first fully digital Doppler broadening positron annihilation spectrometer has been developed and employed to investigate point defects in ZnO single crystals. ZnO crystals were grown by chemical vapor transport method and annealed in hydrogen and deuterium atmospheres. Doppler broadening measurements were carried out in single-detector, coincidence and timestamp acquisition modes. Digital signal processing dramatically improves quality of data and the energy resolution, increasing the sensitivity of the spectrometer. This enables precise measurements of the electron momentum of core electrons which retain the chemical identity and thus reveals the chemical environments of impurities and clusters around defects even for very small concentrations. The electron momentum distributions of as-grown, hydrogen-doped, and deuterium doped ZnO single crystals were measured and expressed as ratio curves of the electron momentum of aluminum. Presence of H and D atoms in ZnO is reflected by a notable change in the obtained ratio curves. The developed system allows detection of very small concentration of clusters, which is significantly important for existing and future ZnO applications in optoelectronic and spintronic devices.

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