Scanning electron microscope cathodoluminescence (CL) and electron beam induced current (EBIC) contrasts of crystallographically defined single misfit dislocations in epilayers of the III–V semiconductor materials GaAs, GaAsP, GaP were analysed. The use of a realistic generation distribution allows an exact calculation and fit to experimental beam voltage dependent contrast profiles of selected surface-parallel dislocation lines. The size of band-to-band emission sites correlates with low-angle grain sizes observed by transmission electron microscopy. © 1996 American Institute of Physics.