

ABSTRACT

A semiconductor device includes a gate electrode structure including gate electrodes spaced apart from each other in a first direction substantially perpendicular to an upper surface of a substrate; insulation patterns disposed between the gate electrodes; a first capacitor electrode extending through the gate electrode structure and the insulation patterns in the first direction, the first capacitor electrode including a metal; a dielectric pattern on a sidewall of the first capacitor electrode; and second capacitor electrodes corresponding to portions of the gate electrodes adjacent to the first capacitor electrode. The first capacitor electrode includes a first extension portion extending in the first direction and first protrusion portions protruding in a horizontal direction substantially parallel to the upper surface of the substrate from portions of a sidewall of the first extension portion that respectively face the insulation patterns in the horizontal direction.

FIG. 6