ABSTRACT

A semiconductor device includes a vertical pattern including a first source/drain region, a second source/drain region having a height higher than a height of the first source/drain region, and a vertical channel region between the first and second source/drain regions, a gate structure facing a first side surface of the vertical pattern, and a back gate structure facing a second side surface, opposite to the first side surface of the vertical pattern. The gate structure includes a gate electrode on the first side surface of the vertical pattern, and a gate dielectric layer including a portion disposed between the vertical pattern and the gate electrode. The back gate structure includes a back gate electrode on the second side surface of the vertical pattern, and a dielectric structure including a portion disposed between the vertical pattern and the back gate electrode. The dielectric structure includes an air gap.

FIG. 3