

A methodology of using five discrete mushroomlike loadings to reduce the mutual coupling of a closely spaced four-element multiple-input multiple-output antenna system is presented in this paper. The occurrence of the loadings concentrates part of the near fields of the substrate integrated cavity-backed slot (SICBS) antenna element and changes the near-field distribution between each antenna elements, so that the mutual coupling between the antenna elements can be greatly reduced. The loaded four-element SICBS antenna system with an overall size of  $1.2\lambda_0 \times 1.2\lambda_0 \times 0.11\lambda_0$  ( $\lambda_0$  is the free-space wavelength at the 2.4 GHz) realizes the mutual coupling reduction of 14 dB between the antenna elements along the diagonal lines with identical polarization, while keeping the mutual coupling of the orthogonally placed adjacent elements unchanged over the band of 2.4-2.485 GHz. With the mutual coupling lower than -35 dB between each antenna element pair, the envelope correlation coefficient is less than 0.005 across the operating bandwidth of 2.4-2.485 GHz.