

Design of Intelligent Reflect Surface Using Liquid Crystals

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Intelligent Reflect Surface (IRS) technology which electrically controls the direction of reflected beam has attracted recent years. A representative phase control technology for implementing IRS is a reflect array using diodes, however, low efficiency is one of the problem due to losses of diode in the millimeter wave band, binary phase changes and harmonics. IRS using liquid crystal (LC) is also expected, however, high voltages are required for each array elements to change the dielectric constant of the liquid crystal, and usual change of the dielectric constant is less than 1.

Figure 1 shows the basic configuration of a LC-IRS for one-dimensional beam scanning and the prototype of LC-IRS. To perform one-dimensional beam scanning, the reflectarray element in the vertical direction are connected by a bias line and the reflection phase is controlled by applying different voltages to the array elements. The structure consists of a three-element dipole and a bias line in an unit cell. The change of reflection phase is around 200 degrees in case when one-element dipole in an unit cell are used and three-element dipoles with slightly different lengths result in the phase change of up to 400 degrees.

In this paper, the extraction of problems in the design of LC-IRS are discussed experimentally. Measurement system to evaluate the scattered field from LC-IRS are constructed and amount of the phase shift are evaluated with changing the structure of LC-IRS. Furthermore, the design guidelines to reducing the driving voltage and to increasing the response speed of the liquid crystal are discussed regarding the thickness of the liquid crystal.

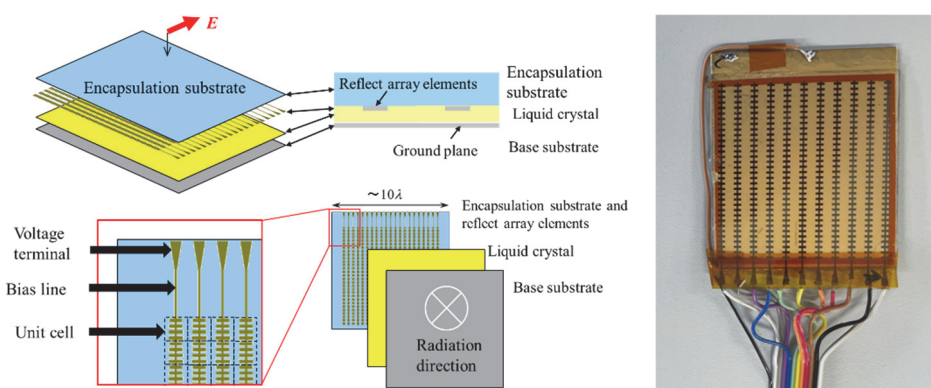


Figure 1. Structure of Intelligent Reflect Surface (IRS) using Liquid Crystals and its prototype.

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References

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