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Realization of high performance random laser diodes[1]

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For the past four decades, extensive studies have been concentrated on the understanding of the physics of random lasing phenomena in scattering media with optical gain. Although lasing modes can be excited from the mirrorless scattering media, the characteristics of high scattering loss, multiple-direction emission, as well as multiple-mode oscillation prohibited them to be used as practical laser cavities. Furthermore, due to the difficulty of achieving high optical gain under electrical excitation, electrical excitation of random lasing action was seldom reported. Hence, mirrorless random cavities have never been used to realize lasers for practical applications – CD, DVD, pico-projector, etc. Nowadays, studies of random lasing are still limited to the scientific research. Recently, the difficulty of achieving 'battery driven' random laser diodes has been overcome by using nano-structured ZnO as the random medium and the careful design of heterojunctions. This lead to the first demonstration of room-temperature electrically pumped random lasing action under continuity wave and pulsed operation. In this presentation, we proposed to realize an array of quasi-one dimensional ZnO random laser diodes. We can show that if the laser array can be manipulated in a way such that every individual random laser can be coupled laterally to and locked with a particular phase relationship to its adjacent neighbor, the laser array can obtain coherent addition of random modes. Hence, output power can be multiplied and one lasing mode will only be supported due to the repulsion characteristics of random modes.

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