Information Technology

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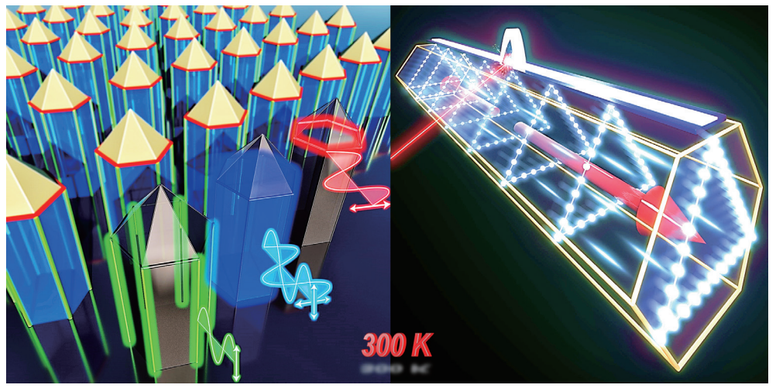
Room temperature quantum photonics research exploiting pencil-shaped hexagonal microrod structures

Since III-nitride based semiconductors obtain bright emission in the visible range at room temperature, we can easily access as LED and laser in our life. Conventional planar structures are limited to fabricate low dimensional quantum structures and cavity structures, which are necessary for the research of quantum photonics. In our approach, we employed a pencil-shaped hexagonal microrod structure to solve these complex problems. Exploiting the pencil-shaped rod structures as a backbone for the subsequent growth, the well-controlled quantum wire structures are spontaneously arranged and applied for orthogonally polarized, dual-wavelength compact light sources. Using the cross-section of the rod as a microcavity, we observed the hybrid nature of excitons and photons (exciton polariton) and manipulated the polaritonic condensate at room temperature. Our proposed pencil-shaped hexagonal microrod structures can be expected as a new platform for semiconductor based quantum photonic operating at room temperature.



Research outcomes

[Paper] • S. Choi†, H. G. Song†, S. Cho, Y. H. Cho*, "Orthogonally-polarized, dual-wavelength quantum wire network emitters embedded in single microrod", Nano Letters 19, 8454 (2019). [2018 Impact Factor = 12.279]

• H. G. Song, S. Choi, C. H. Park, S. H. Gong, C. Lee, M. S. Kwon, D. G. Choi, K. Y. Woo, and Y. H. Cho*, "Tailoring the potential landscape of room-temperature single-mode whispering gallery polariton condensate", Optica 6, 1313 (2019). [2018 Impact Factor = 9.263]

Information Technology

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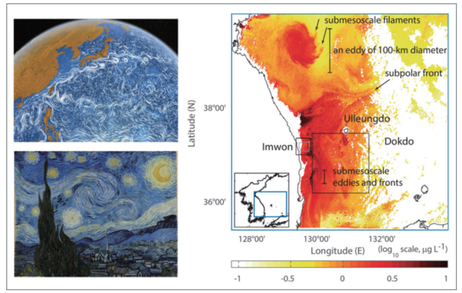
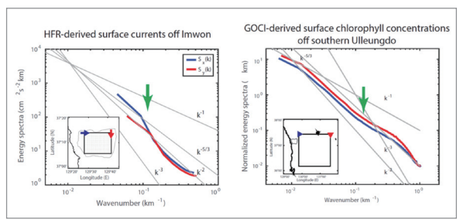
Quantification of oceanic energy injection scales and elucidation of primary drivers through submesoscale observations

The injection spatial scale and primary driver in the oceanic submesoscale processes have been reported as O(10)-km scale baroclinic instability for the first time ever in the world based on the analysis of O(1) km and hourly surface current and chlorophyll concentration maps, observed by remote sensing instruments of high-frequency radars and geostationary ocean color imagery for at least one year up to five years. This work elucidates the pathways of oceanic energy cascades and will enhance studies of bio-physical interactions and improve the performance of regional and global climate model through realistic parameterization at submesoscale. The scientific outcomes have been published as two companion papers in Journal of Geophysical Research-Oceans, one of prestigious and top-shelf journals in earth science and geophysical fluid dynamics.



[Figure 1]
Examples of mesoscale turbulent fluids manifested in the 'Perpetual Ocean' created by NASA's Goddard Space Flight Center and 'The Starry Night' of Van Gogh (left). Examples of submesoscale turbulent fluids surface concentration of chlorophyll concentration maps (right).



[Figure 2]
Energy spectra of the HFR-derived surface currents and GOCI-derived chlorophyll concentrations in the cross-shore and along-shore directions.
Injection spatial scales (Green arrows)

Research outcomes

[Paper] • Lee, E. A. and S. Y. Kim, 2018: Regional variability and turbulent characteristics of the satellite-sensed submesoscale surface chlorophyll concentrations, J. Geophys. Res. Oceans 123(6), 4250 - 4279

• Yoo, J. G., S. Y. Kim, and H. S. Kim, 2018: Spectral descriptions of submesoscale surface circulation in a coastal region, J. Geophys. Res. Oceans 123(6), 4224 - 4249

[Win a Prize] • Minister of Oceans & Fisheries Republic of Korea, 2019 Academic Part Excellence Award for Marine Fisheries Science and Technology