All-optical control of light functionality in WS_2-coated microfiber knot resonator with high sensitivity

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1. Introduction

One of the most important parts in the modern communication system is optical fibers. By reducing the fiber diameter to microfibers, it can extend the scope of the fiber. And it will facilitate light-matter interaction applications. Because the resonance property can be tuned by external stimuli that the microfiber knot resonator (MKR) can be an excellent one among different microfibers based structures[1,2]. In addition to the structure, WS_2 as a two-dimensional material has a lot of strong points. Like high electron mobility, high on/off ratio and tunable refractive index by light absorption in the visible regime[3,4].

2. General Instructions

It needs to taper a MF before MKRs, which is used to form the MKR. We use the method of heat-flame taper-drawing to taper a SMF1. After that, the MKRs are assembled by using translation stages and microscopes. A highly cleanliness of MgF_2 crystal substrate will be used for carrying MKRs. Figure 1 (a) shows one MKR structure by a microscopic image, it painted a loop diameter D ≈ 968 μm of the MKR moreover and the inset shows the waist region of the MF with a diameter ≈ 5.46 μm. To avoid a low output power, it need to choose a suitable portion to coat WS_2.

Experimental result will be presented which include the transmitted light tuned by external violet/red pump light power for the structures of MKR with and without WS_2. The two ends of the MKR structure are connected to the TLS and OSA. The laser was focused by the cylindricallens. Figure 1 (b) shows the result of the output spectra for the MKR with WS_2 structure at around 1572.7 nm. The transmitted power become higher with the increase of external violet pump light power, and it has a red shift of the λ_{res} position.

3. Conclusions

In the end, an all-optical control of light functionality has been demonstrated in the structure of MKR with WS_2 nanosheets. Due to the variations in both the real and imaginary part of WS_2 conductivity, the tuning of both the transmittance and the λres under different violet/red pump light powers can be achieved. The averaged rise time of the sample is ~ 0.12 s, and the averaged fall time is ~ 0.13 s.

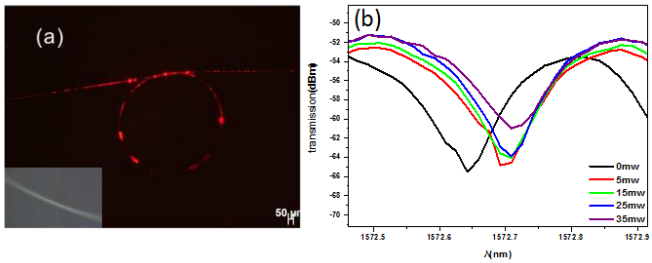

Figure 1: (a) Microscopic images of the MKR and the inset shows the waist region of the MF (b) Transmission of the MKR with WS_2 structure at different external violet pump light power excitation.

References

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