Optical Analysis On Infiltration Of Rhodamine Dye Inside Nanoporous Anodic Alumina Gradient index Filters

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INTRODUCTION

In this work, we have demonstrated the use of optical properties of NAA-GIFs to assess the molecular loading profile of Rhodamine 6G dye (serve as a model drug). The structural tuneability of photonic stopbands in NAA-GIFs allows one to obtain one of the bands in the same range as the absorption of the model drug while the second stopband is placed far away from the absorption region. This permits to relate the ratio between the maximum reflectances of the two stopbands as a metric for filling the nanoporous structures with the dye molecules. In addition, drop/dry method has been shown to be a simple and effective strategy to fill the pores.

FABRICATION OF NANOPOROUS GRADIENT INDEX FILTERS

Sample	I_0 (mA/cm^{-2})	I_1 (mA/cm^{-2})	T_1 (s)	T_2 (s)	N
NAA_GIFs_01	2.6	1.3	170	260	200
NAA_GIFs_02	2.6	1.3	180	265	200
NAA_GIFs_03	2.6	1.3	180	265	200

Stacked Photonic structures were fabricated in 0.3 M oxalic acid (H2C2O4) at 5ºC by applying current density-time anodization profile

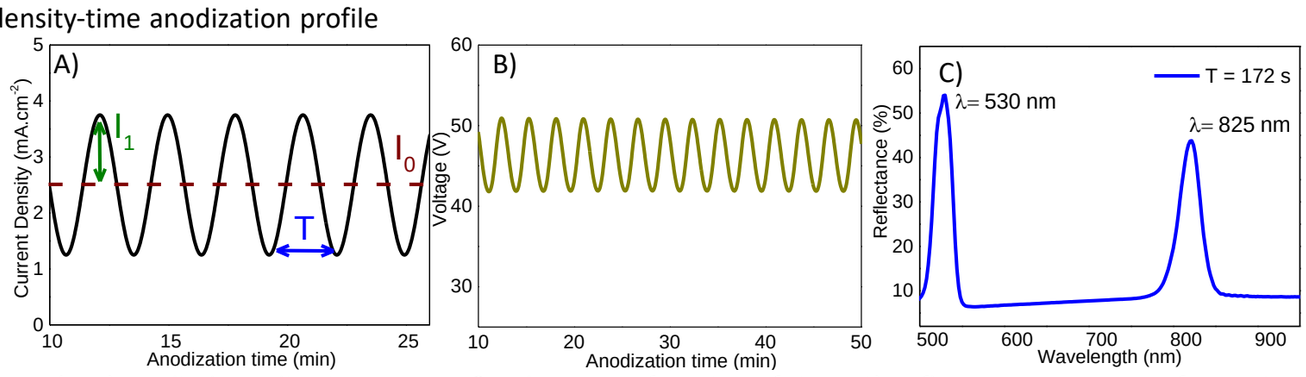
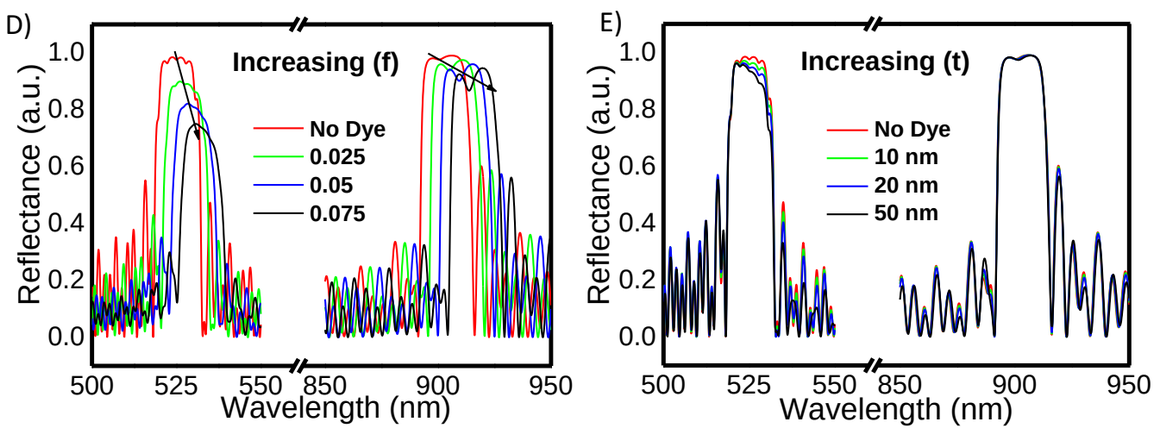


Figure (A-B) Applied anodization current & voltage as a function of time, C) Reflectance spectrum of NAA-GIFs

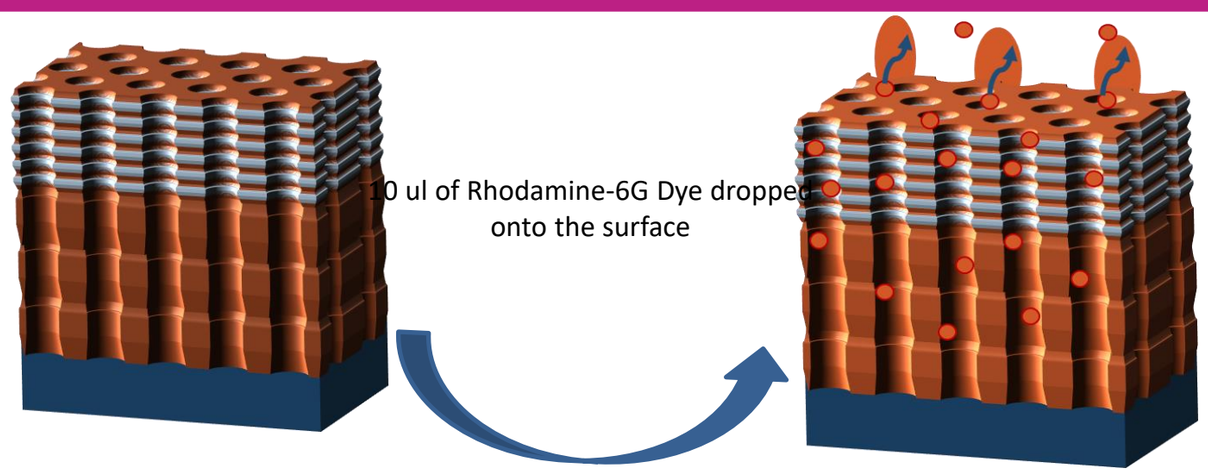
SIMULATIONS



(f) = fraction of molecule inside the pores, (t) = thickness of a film with the optical properties of the molecule.

Figure (D & E) Simulations show that the relative reflectance of the stopbands does change when f changes and does not change when t changes

DROP/DRY ANALYSIS



Different sets of samples were fabricated and 10 µl of Rhodamine 6G dye prepared in DMSO and water was dropped on to the surface of NAA-GIFs and left at room temperature for air dry. This drop/dry cycle was repeated for 6 times to obtain the desired results. Once dried the samples were measured through UV-Visible spectrophotometry for reflectance measurement at an incidence angle of 8º at different positions and an average reflectance were obtained.

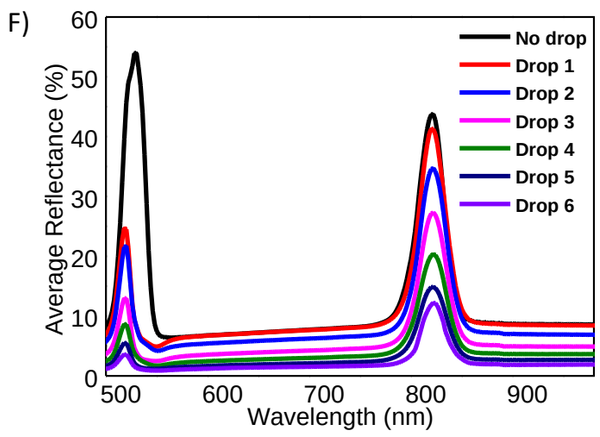
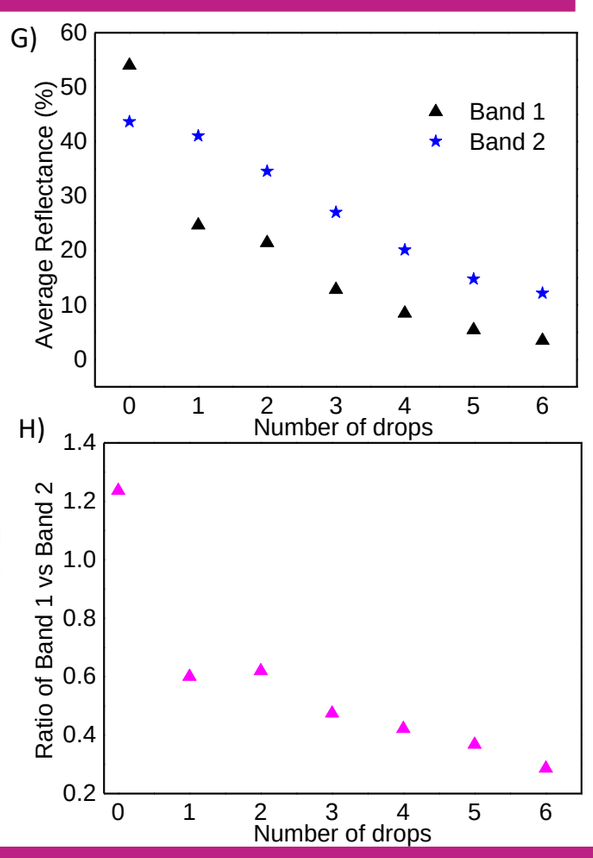
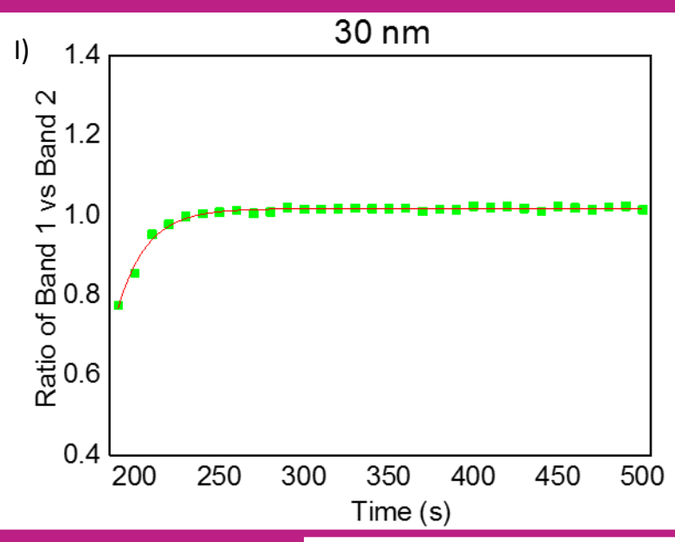


Figure F) shows reflectance spectrum after each drop of dye; G) Plot of maximum reflectance vs number of drops; H) Ratio of Peak 1/Peak 2.



RELEASE PROFILES USING RIfS

Figure I) represents release profile from 30 nm pore diameter loaded with Rhodamine 6G Dye using RIfS technique. Based on the measurements a correlation between relative height of stopband 1 vs stopband 2 was plotted as a function of time



CONCLUSIONS

Here in we demonstrate the periodically engineered NAA-GIFs structures and their subsequent filling with rhodamine-6G dye using drop/dye cycle. This filling has been studied using reflectance measurements to extract information about the filling process and the data has been further analyzed to evaluate the molecular load inside the nanopores by comparing the height changes of the peak. A ratio between both the peaks has been established and considered one of the important parameter to be investigated in further experiments to gather release dynamics of the dye. Release dynamics were evaluated and fitted with an exponential decay function indicating the observable release pattern from the nanopores.

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