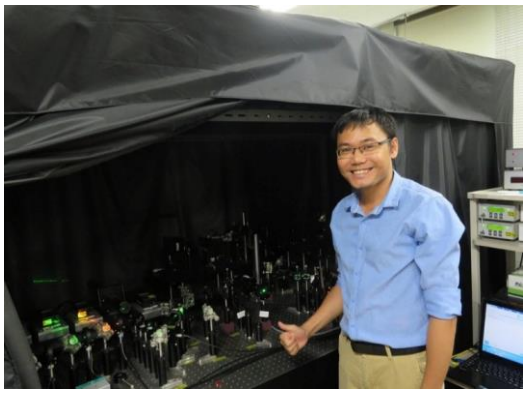
受入大学名	京都工芸繊維大学		
Host University	Kyoto Institute of Technology		
外国人研究者	ジャン・ゴック・ハ		
Foreign Researcher	GIANG NGOC HA		
受入研究者	堤　直人	職名	理事・副学長
Research Advisor	TSUTSUMI Naoto	Position	Trustee・Vice-President
受入学部/研究科	工芸科学研究科		
Faculty/Department	Graduate School of Science and Technology		

＜外国人研究者プロフィール/Profile＞

国　籍	ベトナム
Nationality	Vietnam
所属機関	ホーチミン市立食品工業大学
Affiliation	Ho Chi Minh City University of Food Industry
現在の職名	講師
Position	Lecturer
研究期間	2019年7月14日　～　2019年10月11日　（90日間）
Period of Stay	90 days (July 14, 2019 - October 11, 2019)
専攻分野	高分子材料科学
Major Field	Macromolecular Science and Engineering



Photorefractive Degenerated Four-Wave Mixing Optical

＜外国人研究者からの報告/Foreign Researcher Report＞

①研究課題 / Theme of Research

Photorefractive (PR) effect is interesting not only in academic researches but also in real-time holographic application. In this study, the trapping phenomenon in PR polymeric composite shall be investigated by varying many components and the addition of graphene quantum dots (GQD). Poly(4-diphenylamino benzaldehyde) (PDAA) is used as the main polymer matrix. 4-diphenylamino)phenyl)methanol (TPAOH), the photoconductive plasticizer shall be added. The NLO property of the composite is achieved by adding 2-(4-Azepan-1-yl-benzylidene)-malononitrile (7DCST) or 2-(4-(bis(2-methoxyethyl)amino)benzylidene)malononitrile (AODCST). Through the transient photocurrent, the trapping and effect of each component related to degenerated four wave mixing result could be revealed.

②研究概要 / Outline of Research

PR composite was characterized with 532 nm degenerated four wave mixing (DFWM) technique at KIT and 640 nm photocurrent (PC) measurement (40 V/μm) at RIKEN. The research outline was as following:
- Effect of senitizer PCBM concentration: the other component was kept constant while PCBM concentration was changed (0.3; 0.6; 0.9)
- Effect of plasticizer: The plasticizer of 4-diphenylamino)phenyl)methanol (TPAOH) were compared with 2,4,6-trimethyl-N,N-diphenylaniline (TAA)
- Ratio of plasticizer: The concentration of polymer PDAA was kept constant at 35 wt% while the ratio of TPAOH and 7DCST was varied (30/35; 20/45; 10/55)
- Effect of GQD: The GQD 0.1 wt% was added into the system consists of PDAA/7DCST/TPAOH/PCBM (35/30/35/0.6) or PDAA/AODCST/TPAOH/PCBM (50/30/20/0.6)

③研究成果 / Results of Research

With a small amount of GQD (0.1 wt%), the photocurrent was significantly reduced (approximately 10 times). The shallow trap was largely increased. The response time of the sample with GQD was significantly slower. A similar phenomenon was obtained by using AODCST. Although the absorption of sample with the GQD addition was stronger, it could be hypothesized that the GQD did not contribute to the charge generation of PR composite. Owing to extremely small size (< 100 nm),small concentration but highly conductive material, the GQD was served as strong trap site for the generated charges. On the other hand, adding GQD was proved to enhance the ability to maintain the diffraction signal without irradiation which might be useful for holography recording.

④今後の計画 / Further Research Plan

In this study, PDAA was used as the photoconductive matrix. Although, with triphenylamine moiety and large photocurrent (μA scale, 40 V/μm, 640 nm exciting source), the addition of GQD has significantly reduced the current and worsened the response time. PDAA might not be suitable for the present case. However, the higher HOMO level polymer with larger photocurrent could also not perform good PR properties without blocking layer. Therefore, the next study should focus on the combination of higher HOMO level polymer matrix and GQD. Moreover, the miscibility of GQD (dispersed in water) and photoconductive polymer (dissolved in organic solvent) has to be considered. This problem could be solved by modifying the surface of GQD with alkyl chain.

＜受入研究者からの報告/Research Advisor Report＞

①研究課題 / Theme of Research

The effect of sensitizer, plasticizer, nonolinear optical dye and second trap reagent on the photorefractive polymers. The content of each components is varied and the photorefractive properties and photocurrent dynamics were investigated.

②研究指導概要 / Outline of Research

We provided Giang Ngoc Ha the research facilities in Kyoto Insttitute of Technology. He prepared the photorefractive samples in our lab and measured the photorefractive diffraction behavior using a four wave mixing meaurement facility in our lab. At Riken, transient photocurrent was measured to evaluate the trapping events.

③研究指導成果 / Results of Research

Giang Ngoc Ha did a good job for understanding the each role of the components in the photorefractive polymer composites. I think the present results will open the new sights for understanding the role of the each photorefractive components. We continue discussing for this topic with him including future research plan.

④留学生交流事業の活動状況 / Activities of International Student Exchange Program

Giang Ngoc Ha worked hard in Kyoto Institiute of Technology and Riken for three months. His attitude to the research is sincere. His success of the reaserch is splendid. Fruitful discussion with researcher in Riken strengthen his thinking for research results.

⑤今後の計画 / Further Research Plan

He will summarize the results and will publish the results as a future manuscript with us. As his research plan, he will continue the future research. We will give him a next chance to follow the future research in KIT, Japan.

Weighing nonlinear optical chromophore

Photorefractive sample characterization using optical microscope