The14th International Conference on QiR (Quality in Research)

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In conjunction with :

4th Asian Symposium on Material Processing (ASMP)

International Conference in Saving Energy in Refrigeration and Air Conditioning (ICSERA)

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PREFACE

WELCOME FROM THE RECTOR OF UNIVERSITAS INDONESIA

It is both a pleasure and honor for me to welcome you all to the 14^{th} International Conference on QiR (Quality in Research) 2015. Globalization today results in very competitive atmosphere in all aspects. This flourishing competition should consider the harmony and balance between human needs and the environment quality for creating favorable sustainable future. Steps to ensure the preservation of the environment for our future generations are slowly but surely taken. This fragile balance between the development and innovation of mankind as an effort to enhance their quality of life with its harmony with nature must be maintained as a way to achieve sustainable future - helping us make products and services more efficient, design better buildings, produce safer cars and keep people healthier.

Nowadays, scientists and researchers, hand in hand with industrial experts are creating and developing new green technologies that give us hope for a Sustainable Future. Great minds in Engineering, Architecture and Design areas especially has came up with ideas such as Green Architecture that has the capability to cut down urban resource use dramatically, and making urban expansion sustainable; New Nuclear Material; Waste-Sourced Biofuel/Pyrolysis, where technology is now able to turn biomass waste such as paper, grass or wood chips into gas and eventually ethanol; Biomimicry, that has given the rise to self-healing materials. This in turn will give longer lives to most consumer goods, and thereby reducing the demand for raw materials and waste; and many more innovations that should be encouraged for the motivation of current and future development.

These Green and Smart Technologies can help protect, conserve and even restore our precious shared environment. To develop this technology, we need to combine engineering, scientific or technological approaches, with ecology, economics and the social sciences and humanities. The Green and Smart Technologies innovation field is now wide open and offers exciting new territories to explore and develop. Creative thinking by our top technical and scientific researchers is giving us a more and more treasures of new workable ideas. However, innovations require more than just brilliant ideas. Innovations require resources, skills, technology, knowledge, tools, techniques and so much more. But most of all, innovations require people. People are the driving force behind every need of change, changes that are aimed to improve mankind's quality of life, to enhance their living conditions or to simply make life easier and more comfortable.

This conference is about learning of the fundamental aspects which can transform the world and society, thinking ahead to possible challenges facing the globe, discovering innovations related to opportunities for industry, and most importantly, this conference is about bringing together interdisciplinary people to accelerate activities in many areas simultaneously. This is what makes the conference exceptional this year in terms of potential impact from this networking.

I extend my sincere thanks to the Faculty of Engineering Universitas Indonesia, supporting parties and institutions for their participation and contributions in QiR 2015. I would also thank the people of Mataram especially our colleagues from Universitas Mataram and STMIK Lombok for their gracious support and hospitality. Additionally, I extend a hearty thank you to the members of the organizing committees for dedicating their valuable time so that each one of us enjoys an exceptional conference program over the next several days. May we have a successful, stimulating, fruitful and rewarding conference.

Prof. Dr. Ir. Muhammad Anis, M.Met.
Rector
Universitas Indonesia

PREFACE

WELCOME FROM THE DEAN OF FACULTY OF ENGINEERING UNIVERSITAS INDONESIA

Welcome to the 14th International Conference on QiR (Quality in Research) 2015. The Faculty of Engineering Universitas Indonesia is proud that this year we could once again held an international conference of this grand scale. This two-day, biennial conference is presented together with our co-hosts Universitas Mataram and STMIK Lombok and speaks to the importance of fostering relationships among national and international front liners, thinkers, academics, executives, government and business officials, practitioners and leaders across the globe in an effort to share knowledge and best practices as part of a worldwide network.

For almost twenty years, the first definition of sustainable development and sustainability includes sentences like ‘much remain to be done in the areas of sustainability’ or ‘the underlying science is still far from exact and we all still need to make a big effort’ are common introducing and/or concluding phrases in both literature and scientific forums. I envisioned that QiR will be a platform where academicians, scientists, researchers and practitioners from engineering, architecture, design, and community services to share, discuss, and move forward with their findings and innovations. I hope that the intellectual discourse will result in future collaborations between universities, research institutions and industry both locally and internationally. In particular it is expected that focus will be given to issues on innovations for the enhancement of human life and the environment.

In accordance to this year’s theme, this conference will cover a wide range of green and smart technology issues, especially state of the art information and knowledge of new innovations, ideas, creative methods or applications which can be implemented to enhance the human life with various smart technologies developed to improve mankind’s quality of life and green technologies to make sure that we make a contribution to keeping our environment for our future generations. The itinerary for the two days has been carefully planned to ensure a lively exchange of ideas and the development of innovative strategies and there will be many opportunities for everyone in attendance to share their expertise with, and learn from, peers from around the world.

We foresee more and more challenges in our future. Challenges in how to improve our life, how can we enhance our society, how can we make our lives and the lives or our society better? These challenges should be answered together by developing collaborations for future research in various engineering and design areas. Let’s make this conference an international media for exchange of knowledge, experience and research as well as the review of progress and discussion on the state of the art and future trend of prospective collaboration and networking in broad field of eco-based technology development.

My deepest appreciation to our sponsors, supported parties and various contributors for their never ending supports of this conference. I would also like to convey my gratitude to all of our distinguished speakers for making the time to share their knowledge with us. To our fellow researchers and/or practitioners from Indonesia and overseas, welcome and enjoy your stay in this amazing island, Lombok. I would also like to invite all participants in expressing our appreciation to all members of the QiR 2015 organizing committee for their hard work in making this conference another success.

Prof. Dr. Ir. Dedi Priadi, DEA
Dean Faculty of Engineering
Universitas Indonesia

WELCOME FROM THE QiR 2015 ORGANIZING COMMITTEE

Welcome to the 14th International Conference on QiR (Quality in Research) 2015. It is a great pleasure for Faculty of Engineering Universitas Indonesia to be hosting this biennial event with Faculty of Engineering Universitas Mataram and STMIK Lombok, in the spirit of strengthening of cooperation and mutual growth to be world class institution. For the first time, the QiR 2015 is held in Lombok Island, one of Indonesia's beautiful paradise islands. It is with our utmost pleasure to hold this year's QiR 2015 in conjunction with 4th Asian Symposium on Material Processing (ASMP), and International Conference in Saving Energy in Refrigeration and Air Conditioning (ICSERA).

The aim of this International Conference with our selected theme, "Green and Smart Technology for Sustainable Future", is to provide an international forum for exchanging knowledge and research expertise as well as creating a prospective collaboration and networking on various fields of science, engineering and design. We hope this conference can be a kick-off for the strengthened action and partnerships on creating a platform for us; national and international thinkers, academics, government officials, business executives and practitioners, to present and discuss the pivotal role of engineers in innovative products which will reduce environmental impacts, applications in sustainable planning, manufacturing, architecture, and many more to grow and ensure the rising prosperity of our society going into the future. Under this theme, the conference focuses on the innovative contributions in green and smart technology to encourage and motivate current and future development for achieving sustainable future.

Over the period of 18 years, this biennial international conference started from annual national conference and now has become an important place of encounter between scholars and practitioners from different countries, cultures and backgrounds discussing contemporary engineering and design issues dealt in their hometown, country or even region. Serving as a platform for an engineering and design dialogue, this conference will have 21 invited speakers and has gathered more than 500 papers from more than 17 countries all over the world:
86 papers on International Symposium on Civil and Environmental Engineering
129 papers on International Symposium on Mechanical and Maritime Engineering
121 papers on International Symposium on Electrical and Computer Engineering
107 papers on International Symposium on Materials and Metallurgy Engineering
36 papers on International Symposium on Architecture, Interior and Urban Planning
56 papers on International Symposium on Chemical and Bioprocess Engineering
74 papers on International Symposium on Industrial Engineering
21 papers on International Symposium on Community Development

This year, we have a special talkshow planned as a special session within our plenary lecture. This talk show was planned by our alumni with the theme "***Serve Our Country***". After more than five decades of existence, FTUI has in its library hundreds if not thousands undeveloped innovation ideas and research from its faculties, graduates and students, all of which are aimed at enhancing the quality of human life and the environment, especially in Indonesia. We feel that it's time we contribute more to our country by making sure that these innovations and research can be implemented and produced for a better future of our nation. The talk show will feature some of the most prominent figure in Indonesia's government and will discuss how these innovations can be used by the government in areas such as: electrical, oil and gas, IT, mining, design, manufacture and how the industry can be a part of it.

My deepest gratitude: to all of our speakers, participants, contributors, partners, exhibitors and professional associations, who have given this conference their generous support. I would also like to thank all members of the Organizing Committee, our International Advisory Board and distinguished Reviewers for all of their support and advice. We also owe our success to the full support of the Rector of Universitas Indonesia and the Dean of Faculty of Engineering. Last but not least, a special thanks to our co-hosts, Universitas Mataram and STMIK Lombok for all of their immense supports in making this conference a success.

Allow me to wish all of you a meaningful and rewarding conference. We wish you a pleasant and memorable stay in Lombok. Thank you and we hope to see you again at the QiR 2017.

Dr. Fitri Yuli Zulkifli, ST., MSc.
General Chair of QiR 2015 Organizing Committee

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Synthesis and Characterization of Poly(Acrylamide-Co-Methacrylamide) Gels Material using Raman Spectroscopy

Aris Doyan[1,a] and Susilawati[1,b]

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Keywords: Poly(acrylamide-co-methacrylamide) gels material; Raman spectroscopy

Abstract. In Raman spectroscopy, the inelastic scattering intensity of light is detected after the incident light interacts with the sample. The difference in energy between incident and scattered light is absorbed by the sample in the form of molecular vibrations. Each molecule in the sample has a characteristic set of vibrational modes due to covalent bonds. Fourier Transform Raman spectroscopy was used to investigate the effect of ionizing radiation on polymerization of polymer gels for radiation dosimetry. In the formation of polyacrylamide-co-methacrylamide, Raman intensity was taken at 3040 due to CH_2 stretching modes for the consumption of both monomers. It has been found that the relationship between Raman intensity and dose is monoexponential in which the dose response curves of the formation of polymer and the consumption of monomers and BIS of Raman intensity y at given dose D can be described in the form $y = y_0 + A[1 - \exp(-D/D_0)]$, where y_0 is the Raman intensity at zero doses, A is a constant and D_0 is the dose sensitivity. In this work the dose sensitivity of polymerization may be represented by the change in Raman intensity Δy as a function of dose D for different concentrations of monomer (%M) and cross-linker (%C) by weight. In this case, $\Delta y = y - y_0$ where y is the Raman intensity at dose D. The dose sensitivity D_0 is then determined by fitting the response curves. For PAAm-co-MAAmG system at constant cross-linker, the concentration of MAAm monomer is greatly influenced the dose sensitivity of polymerization. D_0 obtained from PAAm-co-MAAmG system is always greater than that of the PMAAmG and PAAmG systems, which implies that PAAm-co-MAAmG system at 2% BIS cross-linker is less radiosensitive than those of PMAAmG and PAAmG systems. The parameter k_B of MAAm is always greater than that the parameter k_A of AAm, indicating the dose resolution of polymerization of PAAm-co-MAAmG system is controlled by the MAAm monomer rather than the AAm monomer.

Introduction

One of the first applications of Raman spectroscopy to polymer gels used in radiotherapy who able to qualitatively characterize the consumption of acrylamide (AAm) and BIS as a function of dose. They described that the Raman technique is more direct than MRI dosimetry, in that the compositional changes detected are more closely related to radiation-induced copolymerization than are NMR relaxation time changes. In their investigation, FT-Raman spectra were plotted in the spectral range of 200 to 3500 cm^{-1} for each separate 'P6' vial containing the aqueous solutions of gelatin, AAm, BIS and the distilled water [1].

Furthermore there were two methods have been used to pinpoint regions in the polimer gel PAG Raman spectra where polymer formation may be observed. First, a solution of water, acrylamide and BIS was manufactured and irradiated to doses between 0 and 50 Gy. Second, bands that were observed to increase in intensity at higher [2, 3]. The water, acrylamide and BIS solution was manufactured keeping the ratios of acrylamide to water, BIS to water and acrylamide to BIS the same as in standard PAG samples. It is known that, upon irradiation, this solution exhibits a 'go no-go' dynamic where, once initiation has begun, termination only occurs after all monomer has been consumed. Hence, if polymer is to be detected in the Raman spectra at all, this dosimeter should provide the simplest system in which to detect the formation. Spectral features in four separate wavelength regions are observed to form once the water, acrylamide and BIS solution is fully polymerized. These features appear at 27, 1126, 1450 and 2936 cm^{-1} [3].

Polymer formation is monoexponential in the dose range between 0 and 13 Gy. When the data are fitted to the functional form

$$y = y_0 + A(1 - e^{-D/D_0}) \quad (1)$$

The dose sensitivity D_0 (poly) is greater than D_0 (BIS) and equal, within experimental error, to D_0 (AAm). This indicates that polymer formation occurs at a rate similar to the rate of consumption of acrylamide [2].

More recent studies demonstrated FT-Raman spectroscopy was used to determine half dose $D_{½} = D_0 \ln 2$ (the half-dose for the production of polymer, which is half of the dose required to produce the amount of polymer formed at high dose depends on the nature of the co-monomers used) for both acrylamide (AAm) and BIS in the variable monomer concentration series [4].

Materials and Methods

The gels were composed of acrylamide (AAm) and methacrylamide (MAAm) from 2 to 6% respectively as monomers, N, N'-methylene-bis-acrylamide (BIS) 2% as crosslinker, gelatin and deionised water in appropriate proposition by weight. The concentration of gelatin was fixed at 6% throughout and the PAAm-co-MAAmG is completed with deionised water. All monomers were obtained from SIGMA chemical Co (St. Louis, Mo, USA) and were of electrophoresis grade (99%).

The polymer gel dosimeters were synthesized in a nitrogen glove-box according to [5, 6]. The monomers and gelatin were dissolved separately in three reaction flasks with equal amounts of the total water volume. In the first reaction flask, all the monomers in half of the amount of deionized water were heated to a constant temperature at 55°C for 2 hours. In the second reaction flask, the gelatin and another half of the amount of deionized water were also heated to a constant temperature at 55°C for 2 hours to dissolve the gelatin. Subsequently, third solutions were allowed to cool down to 30°C for about 1 hour to avoid spontaneous heat-induced polymerization before mixing. A peristaltic pump was used to mix the monomers with the gelatin via Tygothane flexible tubing and stirred at 1000 rpm to form polymer gels. The gel was pumped into screw-top "P6" glass vials using the second peristaltic pump. The manufacture and collection of the gel dosimeters were conducted in oxygen free environment inside a transparent plastic glove box, which was flushed with nitrogen at the flow rate of 60 ml/min in order to expel oxygen that inhibits polymerization prior to gamma irradiation. The oxygen concentration was maintained at less than 0.1 mg l^{-1}.

The final gel dosimeters were sealed and kept in a refrigerator for 12 hours before irradiation. For the purpose of this work, the gel dosimeters are given acronym index polymer gel x:y, where x is the initial concentration of acrylamide and y is the initial concentration of methacrylamide for poly(AAm-co-MAAm)G.

The irradiation was carried out using the gamma source, Eldorado 6&8 Co-60 teletherapy (Atomic Energy of Canada Limited) of the average energy 1.25 MeV and a dose rate at 0.58 $Gy.min^{-1}$ that has been calibrated using a Fricke dosimeter. Each polymer gel vial was placed in a polystyrene holder in a water-phantom acrylic tank. The use of polystyrene would not affect the establishment of charged particle equilibrium in the phantom. Each sample vial was irradiated with single dose of gamma rays at dose ranges from 1 to 40 Gy for poly(AAm-co-MAAmG), at 15 cm depth, 60 cm sample to source distance (SSD) set-up and 60×60 cm^2 field size. The phantom temperature during irradiation was constant at 25°C. After irradiation process the samples were stored in the refrigerator at temperature 22°C for 12 hours, before the characteristic using Raman spectroscopy. Personal radiation safety was applied throughout the experiment by the use of interlocking door system of the irradiation room, whereby the window of the radiation source is remained close when the door is ajar and no radiation is exposed to the sample [4].

Results and Discussion

The copolymerization of the monomer and cross-linker of polymer gels in the gelatin matrix could be studied directly using Raman scattering spectroscopy. In Raman spectroscopy, the inelastic scattering intensity of light is detected after the incident light interacts with the sample. The difference in energy between incident and scattered light is absorbed by the sample in the form of molecular vibrations. Each molecule in the sample has a characteristic set of vibrational modes due to covalent bonds. In the formation of polyacrylamide-co-methacrylamide, Raman intensity was taken at 3040 cm^{-1} due to CH_2 stretching modes and at 1633 cm^{-1} due to C=C stretching modes of AAm and MAAm respectively for the consumption of both monomers.

FT Raman spectroscopy studies were used to investigate the effect of ionizing radiation on polymerization of polyacrylamide gels for radiation dosimetry [1, 4]. It has been found that the relationship between Raman intensity and dose is monoexponential [2], in which the dose response curves of the formation of polymer and the consumption of monomers and BIS of Raman intensity y at given dose D can be described in the form $y = y_0 + A\ [1\text{-exp}(-D/D_0)]$ and $y = y_0 - A\ [1\text{-exp}(-D/D_0)]$, respectively, where y_0 is the Raman intensity at zero doses, A is a constant and D_0 is the dose sensitivity. In this work the dose sensitivity of polymerization may be represented by the change in Raman intensity Δy as a function of dose D for different concentrations of monomer (%M) and cross-linker (%C) by weight. In this case, $\Delta y = y - y_0$ where y is the Raman intensity at dose D. The dose sensitivity D_0 is then determined by fitting the response curves.

Fig. 3 shows the intensity of Raman shift spectra of CH_2 stretching mode at 3040 cm^{-1} PAAm-co-MAAm at different doses. The change in Raman intensity as a function of dose at different AAm concentrations, are shown in Figs. 4a to 4b for MAAm concentration from 2% to 6%. The formation of PAAm-co-MAAm increases with increasing dose, as radiation induces more free radicals due to the breakage of C=C bonds of the comonomers of AAm, MAAm and BIS, resulting in the formation of PAAm-co-MAAm. The polymerization is terminated when one of the comonomers is completely consumed. This can be seen from Fig. 4b that the polymerization reaching the saturation point as shown by a flat dose response at higher doses. As AAm increases, the polymerization increases and shifts the saturation point at higher doses. There is a slight increase in polymerization as AAm increases.

Fig. 5 shows D_0 vs. AAm concentration at MAAm from 2% to 6%. For a given MAAm, D_0 increases considerably with increasing AAm. For example, at 2% MAAm, D_0 increases from 8.40 Gy at 2% AAm to 9.46 Gy at 6% AAm. At 6% MAAm, D_0 increases from 13.42 Gy at 2% AAm to 15.10 Gy at 6% AAm. For a given MAAm, a small increase in D_0 can be observed with increasing AAm. This suggests the cross-linker is dominant to the polymerization of PAAm-co-MAAm. The dose resolution of polymerization of PAAm-co-MAAm system can be represented as the parameter k_A that is the gradient of D_0 vs. AAm concentration. The value of parameter k_A (0.27–0.44)(Gy/%M) is constant for different concentrations of MAAm, indicating that the polymerization of PAAm-co-MAAm is influenced by the MAAm concentration, as shown in Fig. 5.

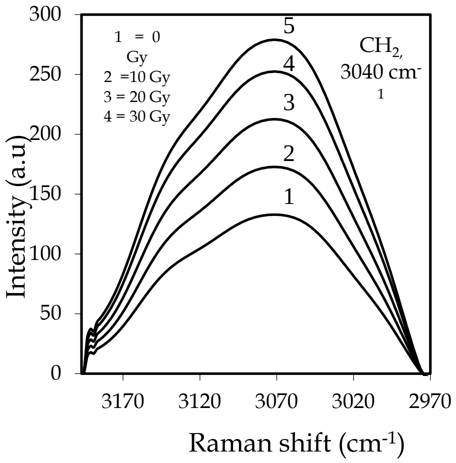

Fig. 3. Intensity of Raman spectra of CH_2 stretching mode at 3040 cm^{-1} of PAAm-co-MAAm at different doses

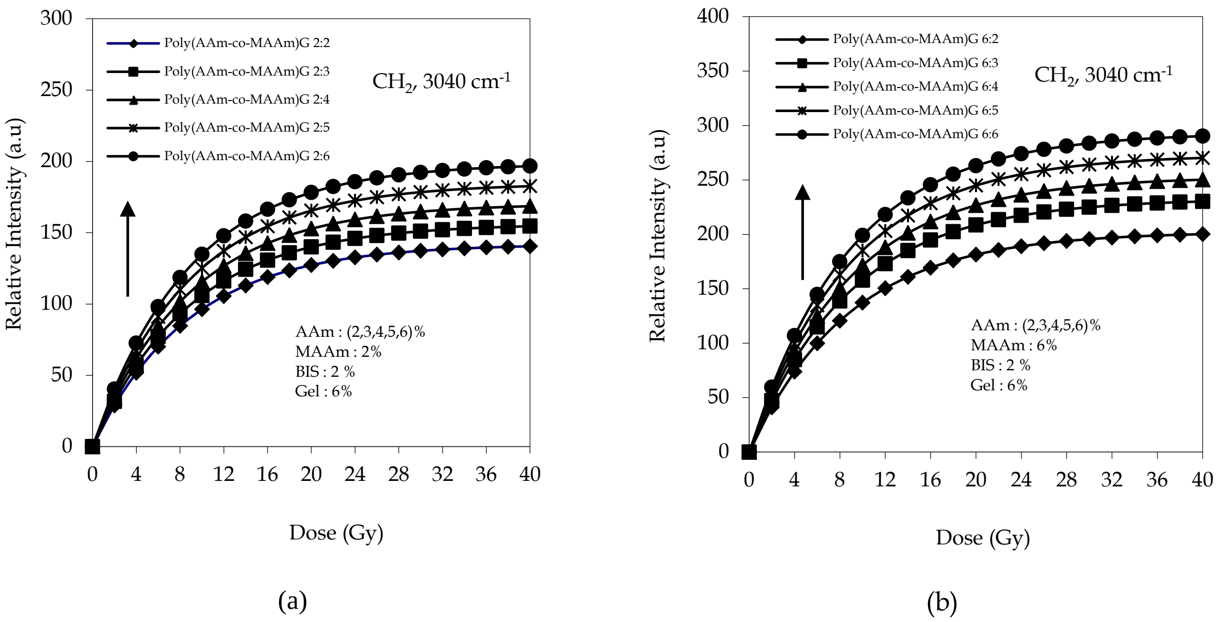

Fig. 4. Changes in relative intensity of CH_2 stretching at 3040 cm^{-1} of PAAm-co-MAAm vs. dose at various AAm from 2% to 6% for MAAm from (a) 2% to (b) 6%

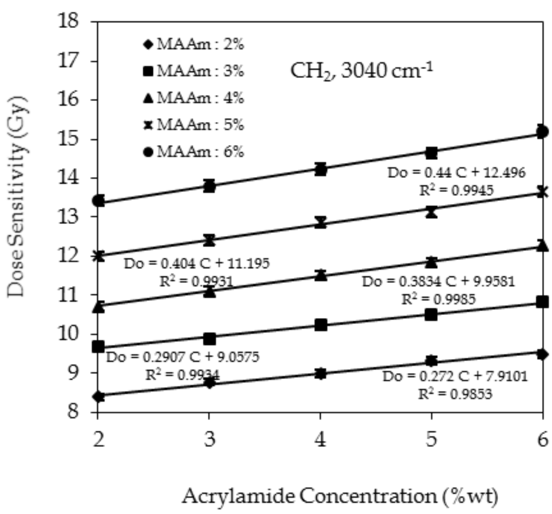

Fig. 5. Dose sensitivity of CH_2 stretching at 3040 cm^{-1} of PAAm-co-MAAm vs. AAm concentration at MAAm from 2% to 6%

Conclusion

In Raman measurement the change of Raman shift for both polymer formation and comonomer consumption were used to characterize directly the dose sensitivity of polymerization of polymer gel systems. For PAAm-co-MAAmG system at constant cross-linker, the concentration of MAAm monomer is greatly influenced the dose sensitivity of polymerization. D_0 obtained from PAAm-co-MAAmG system is always greater than that of the PMAAmG and PAAmG systems [1, 2, 4], which implies that PAAm-co-MAAmG system at 2% BIS cross-linker is less radiosensitive than those of PMAAmG and PAAmG systems. The parameter k_B of MAAm is always greater than that the parameter k_A of AAm, indicating the dose resolution of polymerization of PAAm-co-MAAmG system is controlled by the MAAm monomer rather than the AAm monomer.

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