Comparative Review of Two Papers on Antiviral Activity of Nanocomposites Coatings

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Abstract

In this report, comparative review between two papers about antiviral activity of nanocomposite has been discussed in terms of novelty, importance level, weaknesses points, publishing year, similarities, differences and recommended suggestions. The first article was titled "A Surface Coating that Rapidly Inactivates SARS-CoV-2" by Behzadinasab et al. from Virginia Polytechnic Institute, and the University of Hong Kong, which published in ACS Applied Materials & Interfaces journal in 13 July 2020, Q1, H index 199 (Behzadinasab et al., 2020; Scimagojr 2020). The second one was titled "Protective hybrid coating containing silver, copper and zinc cations effective against human immunodeficiency virus and other enveloped viruses" by Hodek et al. from Institute of Organic Chemistry and Biochemistry, Technical University of Liberec, and Centre for Nanomaterials, which published in BMC Microbiology journal in 01 April 2016, Q2, H index 103 (Hodek et al., 2016; Scimagojr 2020).

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Comparative Analysis

Both papers deal with coating applications to prevent and minimize the indirect spreading way of viruses. They also have used statistical data analysis to evaluate how much of them results valid, and have used a variety of figures, curves and tables to present the data and results. However, there are some differences between materials and methods sections in the two papers. The used materials in the first article were Copper (I) oxide (Cu_2O) and polyurethane (PU), in which a composite material coating prepared by depositing Cu_2O on PU before its full curing on glass or stainless substrates. While in the second paper the materials were cations of silver, copper and zinc, which prepared a hybrid material composite coating on glass and PMMA substrates. That means the first work have higher opportunities to apply on different kinds of surfaces and materials. The tested results in the first paper were virus viability, and activity time, and the used technique to mix the additives into a composite was ex situ polymerization. Also, as it was clear from the supporting information part, XPS and SEM tests have been utilized. In the second paper the tests were FTIR, SEM, virus viability, activity time, and mechanical test for durability which is pull off have been used as well. While in situ polymerization was used to prepare the cations inside the composite materials, in which the nanoparticles were synthesized during the polymerization process.

In results and discussions sections, the activity reduction in the first research was 99.9% of SARSCoV-2, while in the second research was 99.5–100 % on glass, and 75–100 % on PMMA of HIV-1, 97 % of dengue, and 100 % of herpes simplex. However, as the second work was published in 2016, it does not include the recent emergence of COVID-19, and I am wondering if these inactivation results of the prepared coating will be working with this virus. Also, Appling the antiviral coating on different materials surfaces has found with different coating appearance quality, where in the first work was higher

applicable on polymer substrate than others because of the high affinity of polyurethane with polymers. While in the second work it was more suitable on glass than polymer (PMMA), as the authors mentioned that there are higher number of obvious pores on coated polymer. However, both articles have not clearly discussed and evaluated the main mechanism of the prepared composites for antiviral activity. However, in the first one, authors pointed out that copper ions have dissolved and produced highly reactive oxygen sites that could have attacked the virus proteins and degraded it, while in some cases it prevents the virus from the pass to cells. In the second work, authors mentioned the same principles for copper and silver ions, in which these ions damage the virus membranes or attach to thiol active groups of proteins in some cases, while other it is still unknown such in case inactivation of influenza viruses. For the zinc ions and in most antiviral activity cases is still unknown too. This explanation may be as a result to non-known well of antiviral strategies and mechanisms in that time when this paper was published, and lack of related references as well. As a result to that, authors fallen to give an obvious explanation of antiviral activity results for the prepared coatings. For technical notes part, and as the papers have been published in well peer reviewed journals, they show highly level of organization. However, there was a style writing mistake related with the Latin word et al. which is an abbreviation of et aliī, and usually written in italics front, as any foreign word in an English text, where in both mentioned papers has been written without changing it into the italics format. Also, in the second paper, some figures need to replot, such as figure 5, which shows a confusion in the X-axis, and there are a negative value of its error bar too. Regarding the references list, in the first work were about 19 references, in which there was just two references have used from 2020 (10%), and about 6 from 2010 or before (30%). This means there are a lot of related references that have missed for the authors for considering, as the COVID-19 researches have been progressed widely since December 2019. In the second

work, there were 74 references, and there was not any reference from 2016 (0%), 3 references from 2015 (0.4%), and 22 references from 2006 or before (30%). Consequently, the references list has to be updated to include some more recently and related papers.

Additionally, there were some obvious novelty and limitations in both papers. The significant novelty of the first paper is the high inactivation of COVID-19 that was about 99.9% in most cases, which can apply on a wide range of every day products applications or that has high level of touching between people to spread the viruses, as it were shown in the supporting sheet information for work 1. However, the authors mentioned the inactivation time period was about 13 days, which maybe makes it limited in range of long life applications. Moreover, it is clear in figure 2 and 3 in the first work, there was a detection limit that makes mostly all data located on the same level, which are not. This unobvious data distribution maybe because of the high limitation of used technique in the time course detection of viable titer of virus on coatings samples. Also, I am wondering why the authors used just PU, which was not responsible for antiviral activity. Therefore, it will be possible to use the same additives with getting the same results by using other polymers such as PVA, PMMA or PC, especially when we apply PU coating on glass substrate, it leads losing its optical transparency ability and features that are important in some applications, such as touchscreen in technologic display devices like phone.

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