



Mini Review

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Slime Robot The Future is Here

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Introduction

One day, as I happened to come across work of a team of prominent researchers of The Chinese university of Hong Kong (Dr/Prof. Mengmeng Sun ,Chenyao Tian, Xianghe Meng, Liyang Mao, Xingjian Shen,Hao Bo, Wang Xin, Xie Hui ,Zhang Li) , it immediately ignited my curiosity. As I read the team's research, a new, better future of healthcare and more, seemed closer than ever. I invite you all to accompany me, on this fascinating journey in depth, where the major branches of science coalesce to give us "The Slime Robot" also known as Slime-Bot.

Formed by combining the properties of both liquid based robots and elastomer based soft robots, researchers have introduced us to The Slime Robot. Slime Robot is made up of Sio2 coated magnetic particles (NdFeB) and borax added to a Polyvinyl Alcohol Solution (PVA) making it a hydrogel slime robot (>90wt% water). Slime robot surpasses the above two mentioned robots in all the tests like environmental adaptability, controlled manipulation (deformability ,reconfigurability), self-healing ,conduction and detection of electromechanical signals etc. After undergoing intense experiments, the trajectory of this research looks promising (Figure 1).

Slime Robot



Figure 1: The Slime Robot.

Note*: **DISCLAIMER:** I do not own any right of the image shown in the above picture. I have taken this image from Google where it was shown as the cover image of a you tube video under the channel named CNET where one of the researchers *Dr Li Zhang* explained about The Slime Robot. The name of the you tube video is **Viral Magnetic SLIME ROBOT explained by Creator** (<https://www.youtube.com/user/CNETTV>)

Properties

Now let's dive into the ocean of properties of the Slime-Bot.....

i. Environmental adaptation: Slime robot showed excellent adaptation on varieties of surfaces, including rough terrain and porous materials like paper. The anatomy of human body consists of many different surfaces and barriers that might not bother the slime robot.

ii. Controlled manipulation: The magnetic strength of the Slime Robot can be altered by changing the content of magnetic particles or by adjusting the external magnetic field which changes

the adduction force of the slime-bot with the experimental tube. Either method provides a comfortable and easy way to reconfigure the slime robot into curling mode or endocytosis/engulfing mode or any other mode that is required.

iii. The use of this property is vast and has been mentioned ahead in the scope section of this article.

iv. Self-healing: While trying to understand the usage of slime bot inside human body or anywhere else I came across an essential doubt of it breaking into pieces inside its work area and causing more trouble than health. Well, my doubt didn't last long as researchers have already conducted experiments that proved that if a slime bot suffers a fracture, it has capacity to heal own its own such that all the fragments join together in seconds and retain all the properties as good as in the beginning of the experiment. Not only this, but the slime robot also showed excellent plasticity after healing and commendable endurance under excess strain thus resolving my doubt.

v. Conduction of electricity and detection of electromechanical signals: Slime robot shows excellent prospects in its electricity conducting properties when it was put through another experiment. A circuit was made and had a small led in series. The slime robot was put in series of the circuit before the lead using a VHB tape and the led bulb lit up! Further into the experiment, when the slime bot was cut into half, the circuit broke, and resistance became maximum and led turned off. The slime bot healed itself and the lead lit up again.

The resistance was shown to be related to the strain that the slime robot was put to but the details of the experiment are too vivid to mention here as it has been beautifully depicted in the paper of *Dr Mengmeng Sun* and Team. The team tried a reverse experiment where they attached VHB tape containing slime bot on to skin of the human body and when active movements were made the slime robot could detect the electromechanical signals travelling up and down. Fascinating, isn't it?

Scope

The scope of slime robot seems to be everywhere, from electrical appliances to promising role in health sector. Slime

robot has shown conductive properties which can help in making circuits, finding faults, or even repairing circuits. I can only imagine its usage in space research and technologies! It can also detect electromechanical signals which further make it a good candidate for neurological research.

Focused drug delivery systems have always been a center of research in pharmaceutical industries and slime robot can be used in the same area. It can deliver a drug to its targeted area in the human body thereby reducing the concentration of drug used in chemotherapies, reducing the risks of toxicities, and ensuring a better delivery of the drug to the targeted site.

The engulfing properties of the slime robot or endocytosis can help in transport of any material to or from the body e.g. a shard of glass in between tissue. It can engulf that small particle and transport it to outside of the body without causing any additional damage to the body tissues. It must be mentioned here that due to SiO₂ coating of NdFeB particles, the slime robot has been shown to be NON-TOXIC to human Cells and tissues!

Similarly, the slime robot can be used to remove button batteries ingested by mistake, which otherwise would either need a laparotomic/laparoscopic removal and if not removed even perforation of the organ can happen. That being said, further research and experiments are being done in depth and extensive prospective usages in different areas are being explored.

My Concluding Thoughts

Every new leap in science isn't exempt from the probability of falling short. A promising idea like that of the slime robot is no exception to this doubt. The experiments are interesting, and results are in favour of the robot but until extensive trials are made in organic models in lab (under all the ethical guideline) its usage in medical science will be a big question mark.

A human body is the most complicated and best engineered structure of the nature. Even most advanced procedures and best pharmacological aids aren't free of residual/adverse effects. An innovation like that of the slime bot needs honest support from trials done in lab while taking care of ethical guidelines and noting down of risk/benefit ratio even in the smallest of the procedures.

Slime -Bot seems to be a promising concept for future of medicine as well as numerous other areas. I hope we get to know more about it and who knows, maybe in future slime bot can become a star in the world of technologies and of course, medicine!

Acknowledgements

The research that I have talked about "The Slime Robot" emerges from the brilliant minds of the researchers of The Chinese University of Hong Kong. I have read the paper (Reconfigurable Magnetic Slime Robot: Deformation, Adaptability, and Multifunction) on Slime Robot written by a team of 9 brilliant minds (*Dr Mengmeng Sun, Chenyao Tian, Xianghe Meng, Liyang Mao, Xingjian Shen, Hao Bo, Wang Xin, Xie Hui, Zhang Li*). My views on the Slime-Bot are

my own and have not been influenced by anyone in anyway. My understanding, appreciation, doubts, and conclusions are my own and I hold the utmost respect for the researchers mentioned above whom I also consider as my mentors. I wish the team at CUHK my best wishes for the super success of the Slime-Bot.

Conflict of Interest

None.