

Neuromodulation Technologies – A Spiritual Insight

By MATSATI - December 5, 2020



Neuromodulation is defined by the International Neuromodulation Society (INS) as a field of science, medicine, and bioengineering that encompasses implantable and non-implantable technologies, electrical or chemical, that impact upon neural interfaces to improve life for humanity. In 2009, it was reported that Neuromodulation for disorders of the brain are most commonly deep brain stimulation and had shown little technological advancement in the past 50 years. [1] Sensory neuroprostheses however such as that for retinal and cochlear implants have undergone rapid technological progress over the same period of time. The field of neuromodulation however is constantly growing and evolving. [2] To date, the state of the art continues to consist of electrical, magnetic, or ultrasonic stimulation, but also includes chemical and genetic manipulations as well. Such technologies are capable of modulating neural elements without ablating or injuring the nervous system.

References

1. Russell J. Andrews, in [Progress in Brain Research](#), 2009
2. Clement Hamani, Elena Moro, in [International Review of Neurobiology](#), 2012
3. William C. de Groat, Changfeng Tai, in [Neuromodulation \(Second Edition\)](#), 2018
4. Paulin Andréll, in [Neuromodulation \(Second Edition\)](#), 2018
5. **Abdulmalik Obaid, et. al., "Massively parallel microwire arrays integrated with CMOS chips for neural recording," *Science Advances* (2020). *Science Advances* 20 Mar 2020: Vol. 6, no. 12, eaay2789, DOI: 10.1126/sciadv.aay2789**
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Neuromodulation using electrical stimulation of peripheral or spinal nerves has been approved by the US FDA for treating several disorders of the pelvic viscera. [3] It is

generally believed that electrical stimulation is beneficial due to the effects of the activation of somatic nerves which includes the release of neurotransmitters in the central nervous system leading to modulation of abnormal visceral sensory and motor mechanisms. Studies in animals have revealed that electrical stimulation releases different inhibitory and excitatory neurotransmitters. Neuromodulation techniques have been used since the 1980s for treatment of various things, such as in the relief of pain. [4] There is strong evidence that neuromodulation therapy reduces angina symptoms, and improves functional status and quality of life. There is definitely a lot of value in this technology.

When we think about this neuromodulation technology, we also have the application of mind-reading technology. [5] The brain-computer interface technology is developing fast especially in the area of the ability to read data from our minds. With the idea of mind reading, we also have the issue of ethical challenges due to privacy and risks brought about by national security, or even personal and private security, etc. Some applications for this technology are in military applications for example, helping soldiers paralysed by injuries in battle to regain their ability to move. Other applications are in communicating with team members, even remote located teams, or using AI to advise on battle tactics, etc. The effects of having computer systems wirelessly or directly transmit data to the brain is not known, however, neuromodulation technologies exist such as deep brain stimulation, where electrical impulses are sent to the brain tissue to regulate unwanted movement in medical conditions such as dystonias and Parkinson's disease. The impact of this technology (brain computer interface) may also influence one's mood or personality which may change us at a fundamental level. These effects however are unknown at this time in the current state of the art. These are some of the things that will need to be studied, such as how this technology influences on personality, whether the brain can be manipulated in the sense of legal cases (i.e. murder, stealing, etc) and also in information technology (i.e. privacy, national security, etc) as this technology continues to develop and is adopted on a larger scale.

Recently a paper has been published [5] which discusses a new technology that could help the development of brainwave-controlled devices. This new technology could be used to help amputees, people with paralysis, or people with neurological conditions such as motor neuron disease. This study [5] was conducted on mice and researchers were able to develop an accurate and scalable method to record brain activity across large areas including on the surface and in deeper regions simultaneously. This technique is a very invasive technology, as the researchers combined silicon chip technology with very thin microwires, up to 15 times thinner than the human hair inserting them into the brain. This technology allowed for the simultaneous monitoring of brain activity and this device could also be used to inject electrical signals into precise areas of the brain. The technology described in this study [5] is the basis for a fully integrated brain computer interface system that is being developed by Paradromics, a company founded by one of the authors of the research paper. As we can see, there are a lot of interesting applications for these types of technologies in the field of Neuromodulation. Again, this technology brings with it ethical concerns in regards to security and privacy. We want our thoughts to remain private, not just for our own benefit, but also for the benefit of others. The reason being, we many times withhold our opinion or knowledge so as not to harm someone else. We might actually be horrified if we knew every thought that our spouse, child, parent, teacher, boss, or friend thought. This technology offers a lot of interesting benefits, but also has a much

darker side that may be used for nefarious purposes, and the sky's the limit on the amount of ungodly uses of this technology if and when it is implemented on a mass scale.

The Spiritual Insights that we receive from this type of research is related to the idea of Lashon Hara (לשון הרע). As technology advances, techniques are being developed which are either invasive or non-invasive for achieving the brain-computer connection. The non-invasive technology could be used to read our thoughts without our knowledge. This is related to the Torah in the sense of the most difficult commands found in the Torah. The most difficult commands to keep are those related to Lashon Hara (the evil tongue), regarding improper speech. According to the Torah, gossip and/or slander are serious sins. For example, the Torah forbids causing any deception or embarrassment through speech, even if the statement is true. This is related to the power of speech and of the harm that may follow as a result of what is said. The Scientific research draws out this concept on the harm that may be done due to our speech. In the rabbinic literature, the rabbis compare Lashon Hara to stealing or cheating someone financially. The general conclusion is money lost can be repaid, but the harm done by speech can never be repaired (or taken back and forgotten).

There are two mitzvot in the Torah that specifically address the topic of Lashon Hara (לשון הרע). They are found in the following locations:

ספר ויקרא פרק יט

יד לא-תקלל חרש ולפני עור לא תתן מכשל ויראת מאלהיך אני יהוה: טו
לא-תעשו עול במשפט לא-תשא פני-דל ולא תהדר פני גדול בצדק תשפט עמיתך:
טז לא-תלך רכיל בעמך לא תעמד על-דם רעך אני יהוה: יז לא-תשנא את-אחיו
בלבבך הוכח תוכיח את-עמיתך ולא-תשא עליו חטא: יח לא-תקם ולא-תטר
את-בני עמך ואהבת לרעך כמוך אני יהוה: יט את-חלקתי תשמרו בהמתך
לא-תרביע כלאים שדך לא-תזרע כלאים ובגד כלאים שעטנז לא יעלה עליך:

VAYIKRA / LEVITICUS 19:14-19

19:14 'YOU SHALL NOT CURSE A DEAF MAN, NOR PLACE A STUMBLING BLOCK BEFORE THE BLIND, BUT YOU SHALL REVERE YOUR GOD; I AM THE LORD. 19:15 'YOU SHALL DO NO INJUSTICE IN JUDGMENT; YOU SHALL NOT BE PARTIAL TO THE POOR NOR DEFER TO THE GREAT, BUT YOU ARE TO JUDGE YOUR NEIGHBOR FAIRLY. 19:16 'YOU SHALL NOT GO ABOUT AS A SLANDERER AMONG YOUR PEOPLE, AND YOU ARE NOT TO ACT AGAINST THE LIFE OF YOUR NEIGHBOR; I AM THE LORD. 19:17 'YOU SHALL NOT HATE YOUR FELLOW COUNTRYMAN IN YOUR HEART; YOU MAY SURELY REPROVE YOUR NEIGHBOR, BUT SHALL NOT INCUR SIN BECAUSE OF HIM. 19:18 'YOU SHALL NOT TAKE VENGEANCE, NOR BEAR ANY GRUDGE AGAINST THE SONS OF YOUR PEOPLE, BUT

*YOU SHALL LOVE YOUR NEIGHBOR AS YOURSELF; I AM THE LORD.
19:19 'YOU ARE TO KEEP MY STATUTES. YOU SHALL NOT BREED
TOGETHER TWO KINDS OF YOUR CATTLE; YOU SHALL NOT SOW
YOUR FIELD WITH TWO KINDS OF SEED, NOR WEAR A GARMENT
UPON YOU OF TWO KINDS OF MATERIAL MIXED TOGETHER.
(NASB)*

ספר ויקרא פרק כה

*יד וְכִי-תִמְכְּרוּ מִמְכָּר לְעַמִּיתְךָ אוֹ קָנָה מִיַּד עַמִּיתְךָ אֶל-תּוֹנוֹ אִישׁ אֶת-אָחִיו: טו
בְּמִסְפַּר שָׁנִים אַחֵר הַיּוֹבֵל תִּקְנֶה מֵאֵת עַמִּיתְךָ בְּמִסְפַּר שָׁנֵי-תְבוּאֹת יִמְכַר-לָךְ: טז
לְפִי | רַב הַשָּׁנִים תִּרְבֶּה מִקְנֹתוֹ וּלְפִי מְעוֹט הַשָּׁנִים תִּמְעִיט מִקְנֹתוֹ כִּי מִסְפַּר תְּבוּאֹת
הוּא מִכַּר לָךְ: יז וְלֹא תוֹנוּ אִישׁ אֶת-עַמִּיתוֹ וְיִרְאֵת מֵאֲלֹהֶיךָ כִּי אֲנִי יְהוָה אֱלֹהֵיכֶם: יח
וְעֲשִׂיתֶם אֶת-חֻקֹּתַי וְאֶת-מִשְׁפָּטַי תִּשְׁמְרוּ וְעֲשִׂיתֶם אֹתָם וְיִשְׁבַּתֶּם עַל-הָאָרֶץ לְבִטָּח:
יט וְנָתַנָּה הָאָרֶץ פְּרִיָּהּ וְאָכַלְתֶּם לְשִׁבְעָה וְיִשְׁבַּתֶּם לְבִטָּח עָלֶיהָ*

VAYIKRA / LEVITICUS 25:14-19

*25:14 'IF YOU MAKE A SALE, MOREOVER, TO YOUR FRIEND OR BUY
FROM YOUR FRIEND'S HAND, YOU SHALL NOT WRONG ONE
ANOTHER. 25:15 'CORRESPONDING TO THE NUMBER OF YEARS
AFTER THE JUBILEE, YOU SHALL BUY FROM YOUR FRIEND; HE IS
TO SELL TO YOU ACCORDING TO THE NUMBER OF YEARS OF
CROPS. 25:16 'IN PROPORTION TO THE EXTENT OF THE YEARS
YOU SHALL INCREASE ITS PRICE, AND IN PROPORTION TO THE
FEWNESS OF THE YEARS YOU SHALL DIMINISH ITS PRICE, FOR IT
IS A NUMBER OF CROPS HE IS SELLING TO YOU. 25:17 'SO YOU
SHALL NOT WRONG ONE ANOTHER, BUT YOU SHALL FEAR YOUR
GOD; FOR I AM THE LORD YOUR GOD. 25:18 'YOU SHALL THUS
OBSERVE MY STATUTES AND KEEP MY JUDGMENTS, SO AS TO
CARRY THEM OUT, THAT YOU MAY LIVE SECURELY ON THE LAND.
25:19 'THEN THE LAND WILL YIELD ITS PRODUCE, SO THAT YOU
CAN EAT YOUR FILL AND LIVE SECURELY ON IT. (NASB)*

In Vayikra / Leviticus 19:16 the text states, *טו לא-תִלְךָ רֵכִיל בְּעַמִּיךָ לֹא תַעֲמֹד עַל-דַּם רֵעֶךָ אֲנִי יְהוָה: 19:16 'You shall not go about as a slanderer among your people, and you are not to act against the life of your neighbor; I am the Lord. (NASB)* The Hebrew Word for "slanderer" or "tale-bearer" (KJV) is the word רֵכִיל which is related to one who goes from house to house. Other sources of this word's usage in the Scriptures are found in [Mishley / Proverbs 11:13, 20:19, Jeremiah 6:28, 9:4, and Ezekiel 22:9](#). The idea is the slanderer is like one who goes from house to house, all this one does is gossip. This person who goes from house to house likes to disseminate information about others. We note in the "Information Age" this concept of information as a "goods and products" is very clear. This may have not been as

clear in the past, yet even in ancient days in the writing of the Torah, we find this concept present here in [Vayikra / Leviticus 19:16](#). The rabbinic interpretation is that it is a violation of the command to say anything about another person, even if it is true, or not negative, and not a secret, and hurts no one, this is spreading gossip and may lead to bloodshed. This is why the same sentence goes on saying, *לֹא תִעַמְד עַל-דַּם רֵעֶךָ אֲנִי יְהוָה*, "*do not stand upon the blood (דם) of your neighbor, I am the Lord.*" The Story of Doeg the Edomite (1 Samuel 21-22) is often used to illustrate this situation of Lashon Hara. In 1 Samuel 21-22, Doeg witnessed Achimelekh the Priest give David and his men bread and the sword of Goliath. This would be considered an innocent act intended to aid a leading member of Saul's army to supply them in their need. Doeg reported this to king Saul. Doeg's story was accurate and correct, not negative, not secret, and Achimelekh would have told Saul exactly the same thing if he had been asked (in fact, Saul did ask him later). Yet Saul misinterpreted this tale as proof that Achimelekh was supporting David in a rebellion against the kingdom, and proceeded to slaughter all but one of the Priests at Nob.

In the [Talmud Bavli](#) the entire tractate [Arakhin 15b](#) provides us with a discussion on Lashon Hara:

TALMUD BAVLI ARAKHIN 15B

אמר רבי יוחנן משום רבי יוסי בן זימרא מאי דכתיב (תהלים קכ, ג) מה יתן לך ומה יוסיף לך לשון רמיה אמר לו הקב"ה ללשון כל אבריו של אדם זקופים ואתה מוטל כל אבריו של אדם מבחוץ ואתה מבפנים ולא עוד אלא שהקפתי לך שתי חומות אחת של עצם ואחת של בשר מה יתן לך ומה יוסיף לך לשון רמיה

THE GEMARA RETURNS TO THE TOPIC OF MALICIOUS SPEECH. RABBI YOĤANAN SAYS IN THE NAME OF RABBI YOSEI BEN ZIMRA: WHAT IS THE MEANING OF THAT WHICH IS WRITTEN: "WHAT SHALL BE GIVEN TO YOU, AND WHAT MORE SHALL BE DONE FOR YOU, YOU DECEITFUL TONGUE" (PSALMS 120:3)? THE HOLY ONE, BLESSED BE HE SAID TO THE TONGUE: ALL THE OTHER LIMBS OF A PERSON ARE UPRIGHT, BUT YOU ARE LYING HORIZONTALLY. ALL THE OTHER LIMBS OF A PERSON ARE EXTERNAL, BUT YOU ARE INTERNAL. AND MOREOVER, I HAVE SURROUNDED YOU WITH TWO WALLS, ONE OF BONE, I.E., THE TEETH, AND ONE OF FLESH, THE LIPS. WHAT SHALL BE GIVEN TO YOU AND WHAT MORE SHALL BE DONE FOR YOU, TO PREVENT YOU FROM SPEAKING IN A DECEITFUL MANNER, TONGUE?

The rabbinic interpretation on the location of the tongue, being set behind two gates, (i) the teeth (bone) and (ii) the lips. The reason for this interpretation is in the sense of God having placed the tongue in prison behind two gates, due to the difficulty of restraining the tongue because of Lashon Hara (לשון הרע). Because of these concepts, the rabbis in tractate [Arakhin 15b](#), generally conclude the greatest of sins is that of being a slanderer. This is a similar conclusion to what James writes according to [James 3:1-12](#).

JAMES 3:1-12

3:1 LET NOT MANY OF YOU BECOME TEACHERS, MY BRETHREN, KNOWING THAT AS SUCH WE WILL INCUR A STRICTER JUDGMENT. 3:2 FOR WE ALL STUMBLE IN MANY WAYS. IF ANYONE DOES NOT STUMBLE IN WHAT HE SAYS, HE IS A PERFECT MAN, ABLE TO BRIDLE THE WHOLE BODY AS WELL. 3:3 NOW IF WE PUT THE BITS INTO THE HORSES' MOUTHS SO THAT THEY WILL OBEY US, WE DIRECT THEIR ENTIRE BODY AS WELL. 3:4 LOOK AT THE SHIPS ALSO, THOUGH THEY ARE SO GREAT AND ARE DRIVEN BY STRONG WINDS, ARE STILL DIRECTED BY A VERY SMALL RUDDER WHEREVER THE INCLINATION OF THE PILOT DESIRES. 3:5 SO ALSO THE TONGUE IS A SMALL PART OF THE BODY, AND YET IT BOASTS OF GREAT THINGS. SEE HOW GREAT A FOREST IS SET AFLAME BY SUCH A SMALL FIRE! 3:6 AND THE TONGUE IS A FIRE, THE VERY WORLD OF INIQUITY; THE TONGUE IS SET AMONG OUR MEMBERS AS THAT WHICH DEFILES THE ENTIRE BODY, AND SETS ON FIRE THE COURSE OF OUR LIFE, AND IS SET ON FIRE BY HELL. 3:7 FOR EVERY SPECIES OF BEASTS AND BIRDS, OF REPTILES AND CREATURES OF THE SEA, IS TAMED AND HAS BEEN TAMED BY THE HUMAN RACE. 3:8 BUT NO ONE CAN TAME THE TONGUE; IT IS A RESTLESS EVIL AND FULL OF DEADLY POISON. 3:9 WITH IT WE BLESS OUR LORD AND FATHER, AND WITH IT WE CURSE MEN, WHO HAVE BEEN MADE IN THE LIKENESS OF GOD; 3:10 FROM THE SAME MOUTH COME BOTH BLESSING AND CURSING. MY BRETHREN, THESE THINGS OUGHT NOT TO BE THIS WAY. 3:11 DOES A FOUNTAIN SEND OUT FROM THE SAME OPENING BOTH FRESH AND BITTER WATER 3:12 CAN A FIG TREE, MY BRETHREN, PRODUCE OLIVES, OR A VINE PRODUCE FIGS? NOR CAN SALT WATER PRODUCE FRESH. (NASB)

The tongue is a beast that has not been tamed, it is unruly, it is a deadly poison and restlessly evil, etc. These are very strong words and they echo the rabbinic interpretation in the sense of God having placed the tongue in prison behind two gates, due to the difficulty of restraining the tongue. The Scientific research on technological advances in sensing technology which are being developed as either invasive or non-invasive for achieving the brain-computer connection tends to draw these things out. The non-invasive technology could be used to read our thoughts without our knowledge and then we would not have the option to keep ourselves from violating this command if our thoughts are available for all to see. This is related to the Torah in the sense of the most difficult commands found in the Torah. It is forbidden to even imply or suggest negative things about a person, even if it is done in jest. It does not matter if what is said is a fact, true, and not a secret, these things might be used to commit murder as we saw in the story of Doeg and king Saul.

There are a few exceptions to this command, and one is in the case of being called to a court of law to give testimony. The giving of testimony in a court of law overrides the general prohibition against being a slanderer. There are also two laws in the court of law that protects this command found in the Torah, (i) not testifying against oneself to incriminate oneself (*The Fifth Amendment of the Constitution protects a person from being compelled to incriminate oneself*), and (ii) one does not have to testify against one's spouse (*Spousal privilege: spousal communications privilege or confidences privilege is a form of privileged communication that protects the contents of confidential communications between spouses during their marriage from testimonial disclosure, while spousal testimonial privilege (also called spousal incompetency and spousal immunity) protects the individual holding the privilege from being called to testify in proceedings relating to his/her spouse.*). Also, in limited circumstances, one is permitted to reveal information if someone is entering into a relationship that he would not enter if he knew certain information. Examples would include entering into a relationship with an untrustworthy business partner, or a prospective spouse as being unfaithful as a potential future problem for the husband and/or wife.

In *Vayikra / Leviticus 25:17*, we read the following, וְלֹא תוֹנוּ אִישׁ אֶת-עַמִּיתוֹ וְיִרְאתֶם מֵאֱלֹהֵיכֶם כִּי אֲנִי יְיָ **25:17** הַיְהוָה אֱלֹהֵיכֶם: *'So you shall not wrong one another, but you shall fear your God; for I am the Lord your God. (NASB)* Specifically the phrase וְלֹא תוֹנוּ אִישׁ אֶת-עַמִּיתוֹ *"and you shall not wrong one another."* This is traditionally related to a person in speech, which includes speech that is embarrassing, insulting, deceiving, or causing someone emotional pain. This is related to calling someone by a derogatory nickname, or selling something as a merchant and knowing the product is damaged, or not complimenting a person if you do not mean it, or one is not to sell non-kosher meat to a non-Jew while telling him that it is kosher, etc. The scientific efforts to develop non-invasive technology to read our thoughts could be used nefariously without our knowledge, and this would be a violation of this command in the sense if all of our thoughts are available for all to see. Even if this technology would only allow one person to know our thoughts, this could lead to the situation of Doeg and violate the command of God. These things are related to the Torah in the sense of the most difficult commands found in the Torah. The tongue is the smallest member of our body, yet it can mold us and our character into one that others would despise. Notice how the tongue has the power to discredit our entire body, it can destroy our character, and set the course of our lives as being set on fire by hell itself. Great evil can be wrought by an untamed tongue illustrated in both the Rabbinic literature and in the Bible (i.e. *James 3*). The point of *James 3:9-10* is to be a God controlled or to have a God tamed tongue (*3:9 With it we bless our Lord and Father, and with it we curse men, who have been made in the likeness of God; 3:10 from the same mouth come both blessing and cursing. My brethren, these things ought not to be this way. 3:11 Does a fountain send out from the same opening both fresh and bitter water 3:12 Can a fig tree, my brethren, produce olives, or a vine produce figs? Nor can salt water produce fresh. NASB*) Note this is the Gospel message that was spelled out in the Torah, God dwelling in our midst empowering us to overcome sin. James writes of the tongue being a constructive thing and not a destructive thing. The tongue that was once used for deceit, can be changed and turned to glorify God. James is writing that the tongue has the ability to praise God and curse men, but as being created in the image of God, the tongue should be used to lift others up, edify, and encourage, rather than tearing someone down and criticizing them.

The Scientific research on neuromodulation technologies and the efforts being made towards brain reading technologies reminds us of the issues of Lashon Hara (לשון הרע). These things teach us that out of the same mouth comes both blessing and cursing, but this is not what God had intended. When we draw the scientific research alongside of the Torah, these issues become quickly apparent. Notice how technology itself could lead to the violation of God's Command. This draws in an interesting concept in relation to the Mark of the Beast where we read according to the book of Revelation, those who take the mark will be intentional in their disobedience and rejection of God and His Word (His commands). The scientific idea of mind reading brings with it the issue of ethical challenges due to privacy and risks brought about by national security, or even personal and private security, etc. The nefarious nature of this however goes beyond ethical and privacy issues as this could be used to *"stand upon the blood of your neighbor"* (לא תעמד על-דם רעך), *Hebraic way of describing murder*), which is exactly what happened in the case of Doeg. The Rabbis say the cure to lashon hara is to study the Torah ([Talmud Bavli Arakhin 15b](#)). This teaches us that the study of God's Word is imperative for training our tongue to be gentle, kind, trustworthy, and edifying. James said the tongue is untrainable, this is why we need the Lord God Almighty in our lives and His Holy Spirit in our hearts for the Lord to change us and restrain our tongues. These things only come by our relationship with the Lord God Almighty, and his Son Yeshua the Messiah. Without the Lord's help, the sin of Lashon Hara (לשון הרע) continues out of control. Because of these things, the rabbis compare Lashon Hara (לשון הרע) to the disease of leprosy. The one who is afflicted with leprosy has no hope. In terms of Lashon Hara and the parallel of leprosy, the only hope that one has is in the Lord God of Israel who is able to heal and to keep us from the sin of all sins so that we are able to bring glory to God by every member of our body!

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<https://www.matsati.com>

Dr. Duane D. Miller received his Ph.D., M.S., and B.S. Degree in Chemical Engineering from The University of Akron Ohio. He is currently a Chemical Engineering Researcher. Duane's research expertise has focused upon functional materials development for the control, conversion, and release of process gases in Energy production technologies. His R&D interests include computational chemistry, developing novel technologies for converting biomass to fuels and studying their fundamental interactions during the chemical conversion process. His past experience includes sorbent development for pre- and post-combustion CO₂ and SO₂ capture, selective absorption of H₂S from methane streams, O₂ capture for oxy-fuel combustion, photocatalytic reduction of alcohols, NO_x reduction catalysis, the development of oxygen carriers to combust fossil fuels (CH₄ and coal) for the chemical looping combustion processes, and the extraction of rare earth elements using patent pending sorbents. His research expertise has focused on operando-characterization using Infrared, Raman, and UV-Vis spectroscopy to observe the nature of the catalytic active sites and reaction intermediates under realistic reaction conditions, allowing direct correlation of molecular/electronic structures with catalyst performance during Gas-Solid / Liquid-Solid Adsorption and Photocatalytic Processes with real time online analysis of reaction products using ICP-MS and mass spectrometry. His current work involves a multi-disciplinary approach to developing, understanding, and improving the catalytic gasification of coal and methane, high temperature chemical looping combustion, and the catalytic decomposition and gasification of biomass and coal using novel microwave reactor. He has been studying the Hebrew Scriptures and the Torah for 20+ years and sharing what he has learned. The studies developed for MATSATI.COM are freely to be used by everyone, to God be the Glory!

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