DÆRK DRAGON

Luxury vehicle for Chinese market

LAB University of Applied sciences
Institute of Design
Vehicle Design
Spring 2020
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Abstract

The task of this graduation project was to design an autonomous luxury vehicle for the Chinese market. My goal was to create a symphony of new technology in a luxurious environment. As a result of this project, a 3D model was made and named Dærk Dragon.

Tiivistelmä

Tehtävänä oli suunnitella autonominen luksusajoneuvo Kiinan markkinoille. Tavoite oli luoda uuden teknologian sinfonia ylellisessä ympäristössä. 3D-malli luotiin ja nimettiin Dærk Dragoniksi.

LAB University of Applied Sciences

Content

1. Introduction

The purpose of this project is to research and showcase how an autonoumous high-end luxury vehicle could look like in year 2030, and what kind of new technologies could be incorporated into it. Market area for this project is China, which was selected due to it being fastest growing market area for luxury goods and vehicles. Also, China already today has over 4,4 million millionaires, and that amount is rising.

Market research was mostly done by researching luxury trends, current and upcoming, interpreting luxury goods sales and studying interviews from both, manufacturers and consumers. Technology and material research came up with interesting new ideas. I was even able to combine some of those ideas and create completely new tech ideas to include in the vehicle.

2. Research

2.1 Why China?

China has a population of over 1,4 billion and 4,4 million millionaires. Wealth is growing there quicker than anywhere else. (Credit Suisse Research Institute 2019, 11., 45.) Because of the newborn wealth, market for luxury goods is rising rapidly. Also, younger generations are potential luxury buyers in this market. Chinese luxury consumer's average age is considerably younger compared to other market regions. (Martin Roll 2017).

2.2 What is luxury?

What is luxury? That is a question without a direct answer. My focus was to research what is considered luxury in the chosen Chinese market. Usually luxury is determined as goods across the globe; designer clothes, bags, jewellery, cars, jets, yachts, fine & exotic materials and fine restaurants are something that are usually referred to as luxury. People who usually have access to almost everything because of their wealth, determine luxury more often as an experience rather than goods. " Personal tailored experience" is a line that I most commonly met during my research. So, something special others don't have access to. In a crowded city it could mean as simple as privacy and own space. Add fine materials and intelligence to this equation and there is whole new level, ultra luxury.

2.3 Chinese luxury consumer

Chinese luxury consumer differentiates from U.S. and European consumer by the fact that they' re younger. More than 80% of all Chinese luxury consumers are 25 to 44 years old. The average age of Chinese luxury consumers is 33.1 years, whereas European consumer is 14 and U.S. consumer 25 years older than Chinese consumer. (Martin Roll 2017).
In the luxury car market in China women make up to 50 percent of sales. Women also interestingly prefer more sporty cars compared to men. (The Luxury Conversation 2018, Pan 2017)

2.4 Trends

Luxury trends and fashion gets old quickly nowdays and in the future. That also includes car design. Environmentally friendly trends are widely becoming more popular but quick trends are still going strong. For current dominant trends I looked at lots of photos that are currently trending in Instagram and other social media platforms. The car fashion has moved more and more to the social media and even most of the new car reveals are streamed in YouTube and Instagram. For this vehicle I stayed with classical approach in design with latest and future technology. Of course this vehicle' s design must be trend setting and have the " wow-factor" to be desirable in the luxury market it is aimed for.

2.5 Exotic materials

It is quite impossible idea to think of a luxury vehicle without exotic materials. Carbon fiber and forged carbon fiber are widely used in the vehicle manufacturing. Rare leathers are also used in luxury segment, even though organic based materials are becoming more popular due to being environmentally friendly. Unfortunately, this project is more concentrated to being revolutionary than being best for the environment. Latest and rarest materials are demanded in this segment. The range of exotic materials is so wide that it is nearly impossible to list them all here. My concentration for materials for this project were all forms of carbon fibers, different forms of glass including smart glass displays, leathers and silk. But anything can be used in the vehicle if demanded.

> *Carbon fibres are fibers about 5–10 micrometres in diameter and composed mostly of carbon atoms. Carbon fibers have several advantages including high stiffness, high tensile strength, low weight, high chemical resistance, high temperature tolerance and low thermal expansion.*
>
> *Carbon fibers are usually combined with other materials to form a composite. When impregnated with a plastic resin and baked it forms carbon-fiber-reinforced polymer (often referred to as carbon fiber) which has a very high strength-to-weight ratio, and is extremely rigid although somewhat brittle.* (Wikipedia 2020)

2.6 Technology

Researching new technology was a challenge. First there were drivetrain and power delivery technology options that could be used in the future, as internal combustion engines (ICE) are being banned soon worldwide. Two main options were left on the table; hydrogen fuel cells and lithium ion batteries. Both options use electric motors to deliver power to the wheels. With a bit of brainstorming I came up with a solution that connects both: hydrogen fuel cell electric vehicle with inductive charging lithium ion battery. Induction charging is used in many mobile phones and other smaller items and it can be added to the vehicle.

Next up was to decide the driving option. I chose autonomous driving technology, so the vehicle drives itself without designated driver.

Technology overload for the interior was my main target. I researched for options that could be added but didn't find enough innovative options. I then ideated options that are currently available to make them better. Smart glass displays were interesting idea but it needed some boosting. It is a digital display between layers of glass. I opted to use it on all transparent surfaces of the vehicle which has never been done before. Secondly I liked the idea of gesture control. It is a technology where the user controls demanded things with gestures made with users hand. I then had an idea about adding hologram to help with the gestures.

I found it easier to do gestures when I could literally see what I was doing. For example volume control with gesture on some vehicles is as simple as drawing a circle in the air in the certain spot. With hologram added the user would see a holographic volume knob displayed in front of user's finger to give user visual aid. Voice control is also useful option and it is very easy to use as user simply tells vehicles intelligent user interface a task to perform.

2.7 Benchmarking

There is no direct competition in this segment for this type of vehicle as autonomous vehicle category doesn't exist yet. Rolls-Royce, Bentley, Aston Martin, Mercedes and BMW have made their future vision concepts. Bentley EPX 100 concept and Koenigsegg's recently launched Gemera are probably closest rivals with their luxurious quality and tech.

3. Ideation

3.1 Market

The market area for this vehicle is China. As the target group is wealthy people, China is number one choice because it has 4,4 millionaires and China overtook the U.S. in the number of citizens in the global top 10% of wealth in 2019. This is a concept design study and market for this type of product is very narrow even among wealthy people, so there has to be something extraordinary in the product. There would also be very limited production for this vehicle, and not two vehicles would have similar options to keep every single one unique and more valuable.

3.2 Luxury

Luxury is a wide term. It contains everything from personal experiences to physical products. In this vehicle my goal is to serve luxury with individuality. It has all the technology one could want and any exotic materials customer chooses. In modern world, especially in the crowded cities, having a very own private moving lounge with your own freedom is considered luxury.

3.3 New Tech

The vehicle will contain new technology. The drivetrain will be hybrid of HFCEV with inductive charging. All the ” glass” in the vehicle is smart glass and the customer can choose content that is displayed. Exterior and interior side of smart glass can display different things, because glass is doubled up. Interior features oled touchscreens all around the cabin. Everything in the vehicle is controllable with either voice or gesture or hologram control.

3.4 Materials & structure

Base material for the vehicle is carbon fiber and forged carbon fiber. Exterior, cabin and rims are made out of carbon fiber. Doors and roof are made out of smart glass. Interior features high quality leather or silk or any requested material on the seats and cabin panels. Interior is fully customizable by the customer.

4. Technology

4.1 Drivetrain and power

Drivetrain on this vehicle features completely new hybrid technology of hydrogen fuel cells with inductive charging capability.

Kuva 1. Hydrogen molecule (powerengineeringint.com 2020)

4.1.1 Hydrogen fuel cells (HFC)

Hydrogen fuel cell electric vehicle (HFCEV) converts the chemical energy of hydrogen to mechanical energy by reacting hydrogen with oxygen in a fuel cell to run electric motors. (Wikipedia 2020).

> *In fuel cell technology, a process known as reverse electrolysis takes place, in which hydrogen reacts with oxygen in the fuel cell. The hydrogen comes from one or more tanks built into the FCEV, while the oxygen comes from the ambient air. The only results of this reaction are electrical energy, heat and water, which is emitted through the exhaust as water vapor. So hydrogen-powered cars are locally emission-free.* (Arnold 2019)

4.1.2 Inductive charging

Inductive charging (also known as wireless charging) is a type of wireless power transfer. It uses electromagnetic induction to provide electricity to portable devices. Energy is transferred through inductive coupling. An alternating current is run through an induction coil in the charging station or pad (the primary or transmission coil.) Any moving electric charge creates a magnetic field, as stated by Oersted' s law. The magnetic field fluctuates in strength as the AC current is continually changing amplitude. A changing magnetic field generates an electromotive force otherwise known as Faraday' s law of induction. This makes an alternating electric current in a second induction coil (the receiving, or secondary coil) in the portable device. It is then converted to direct current with a rectifier and used to charge a battery or provide operating power. (Wikipedia 2020)

4.1.3 New hybrid generation

New hybrid technology uses both hydrogen fuel cells and inductive charging. Main power comes from inductive charging while driving on the road with capability to charge moving vehicle. Therefore the vehicle is constantly charging and doesn’t need big battery pack. When driving on a road without inductive charging the vehicle uses hydrogen fuel cells to make power for the battery. This way it is possible to minimize the energy needed to move the vehicle.

4.1.4 Autonomous driving

There are levels from 0-5 of automation. This vehicle is level 5 ” Full atomation” which means it fully operates without a designated driver (Hartwig 2020).

> *Self-driving cars combine a variety of sensors to perceive their surroundings, such as radar, lidar, sonar, GPS, odometry and inertial measurement units. Advanced control systems interpret sensory information to identify appropriate navigation paths, as well as obstacles and relevant signage* (Wikipedia 2020).

4.2 Smart glass display

Smart glass display is a window that has a transparent screen inside of the glass. It functions similar to a normal display and it can show any content that the user demands ie. video playback, starlight, works as a tint etc. All the glass in the vehicle is doubled up, so it has two glass layers. That way the user has interior and exterior screens as separate. Exterior screens on the doors have palm/fingertip sensor as a backup/manual anti-thief protection. Interior screens all over the cabin have touch ability.

4.3 Touch panels

Interior also has more traditional OLED touch panels that wrap around the cabin. The whole front of the ” dashboard” is OLED touchscreen. These OLED panels around the cabin also work as a ambience lighting. User can adjust anything in the cabin with these screens.

4.4 Voice and hologram & gesture control

The vehicle comes equipped with voice control. It also has a more modern hologram and gesture control. Interior is fitted with sensors that recognize user's hand gestures and displays a holographic item to the user. This makes gesture control feel more natural to the user as for example when turning volume up a volume knob is displayed in front of user's hand for more natural control feel.

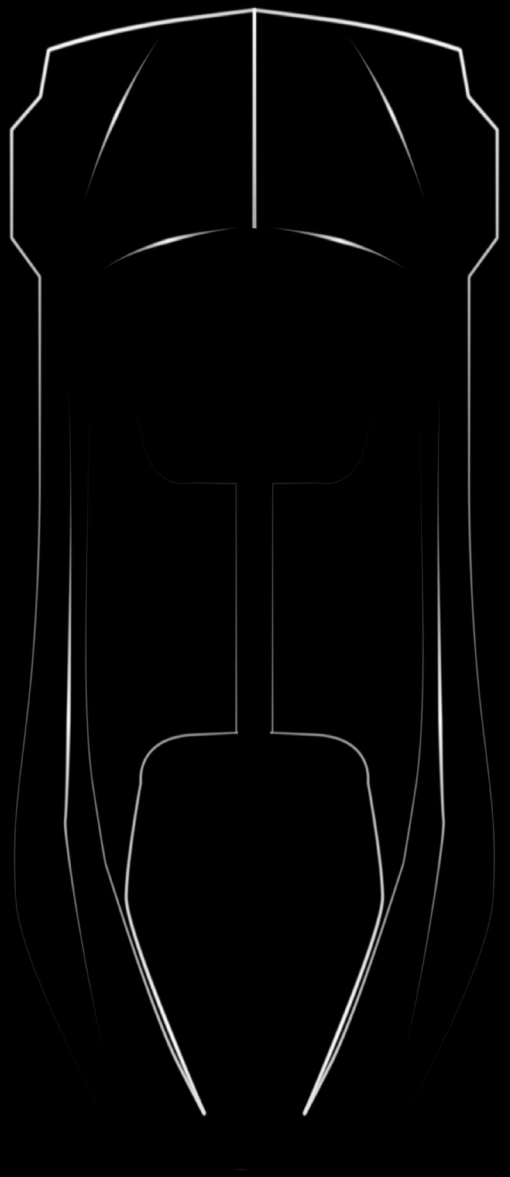
4.5 Other

Vehicle has a hidden sound system to fulfil all audio needs of the user. It also has own air circulation system with highest quality HEPA (High-efficiency particulate air) filters.

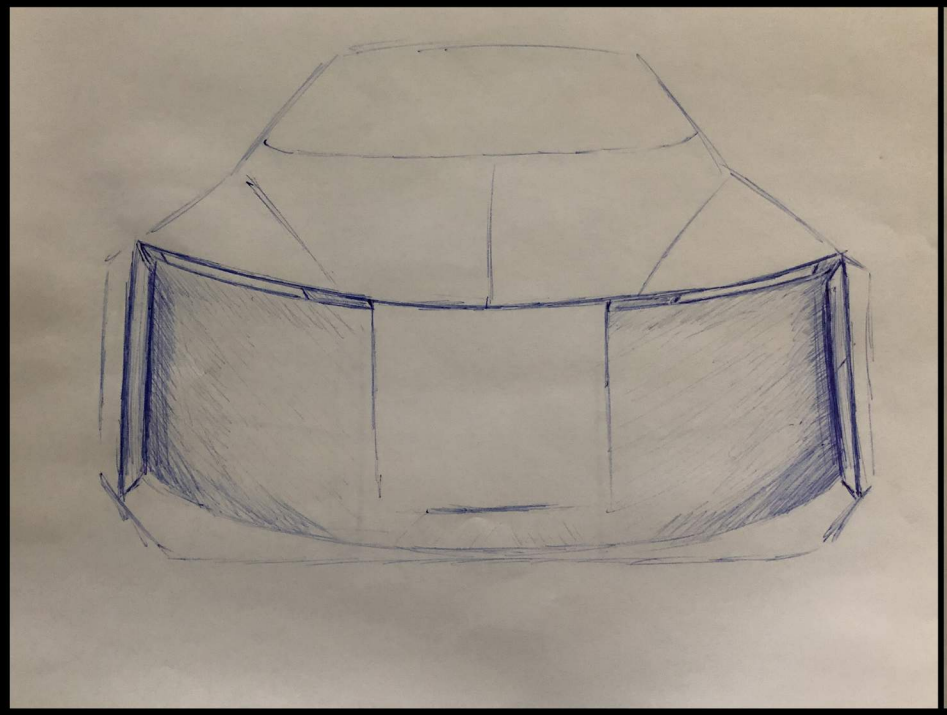
5. Design

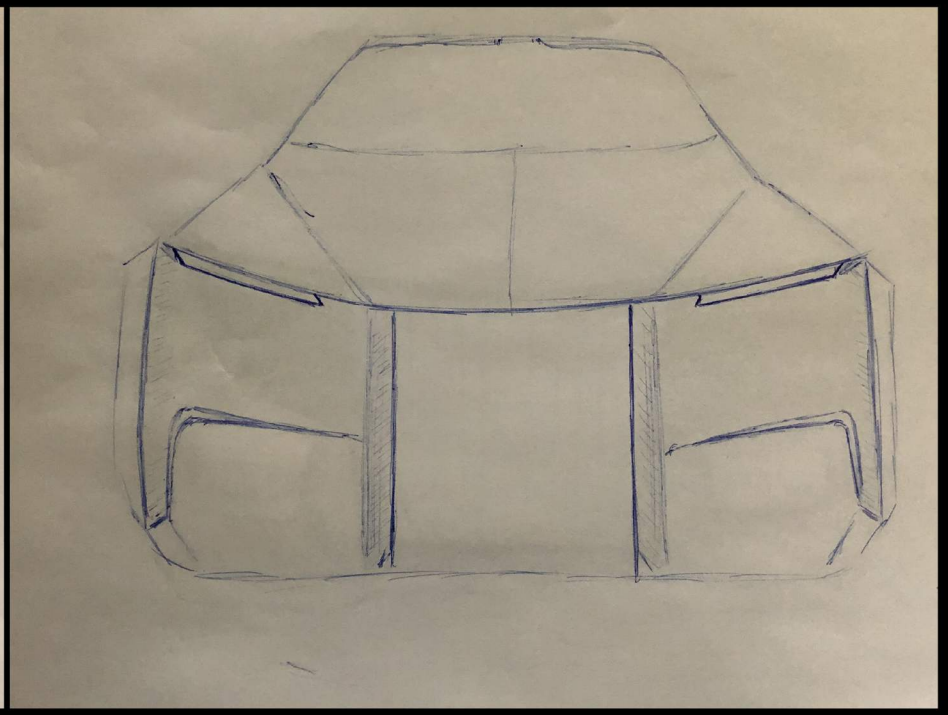
5.1 Sketching

I began sketching with clear idea of vehicles main lines. The front view and the top view were the key sketches for the exterior of this project. For the interior I had ideas about the main lines and features that I wanted to include. Vision of the interior came much clearer once I started 3D-modeling.

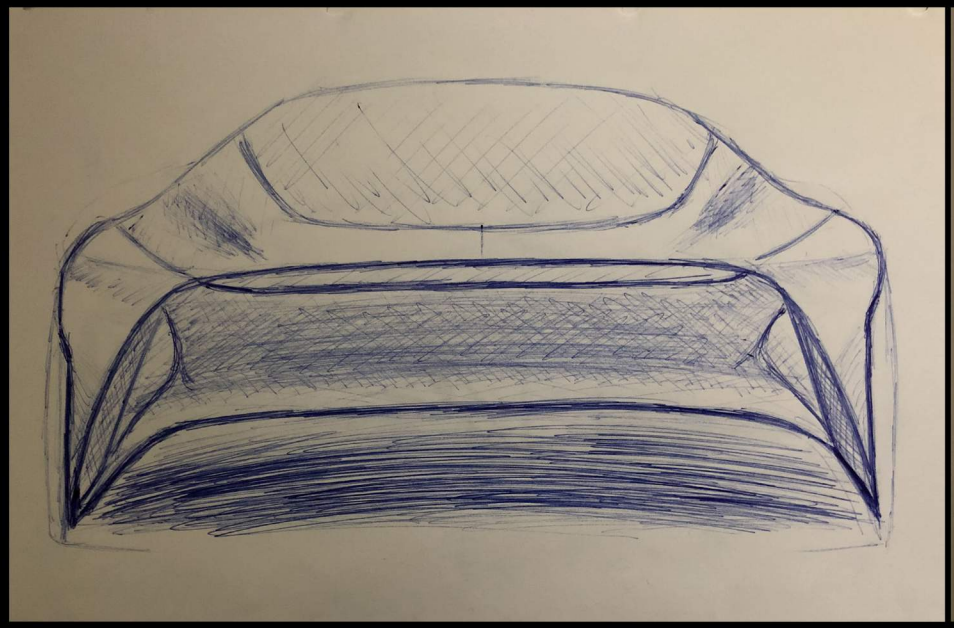


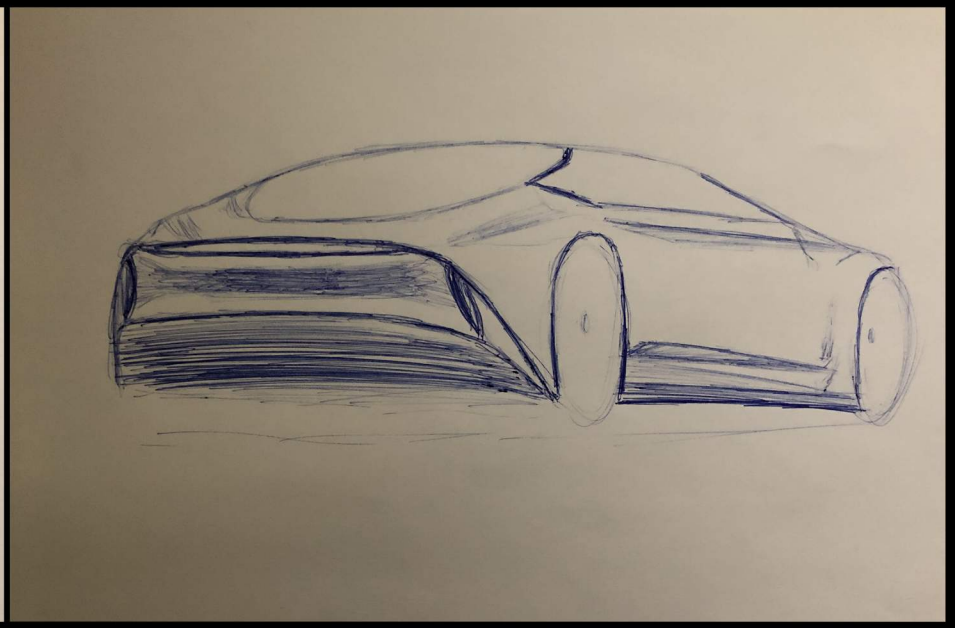
Front



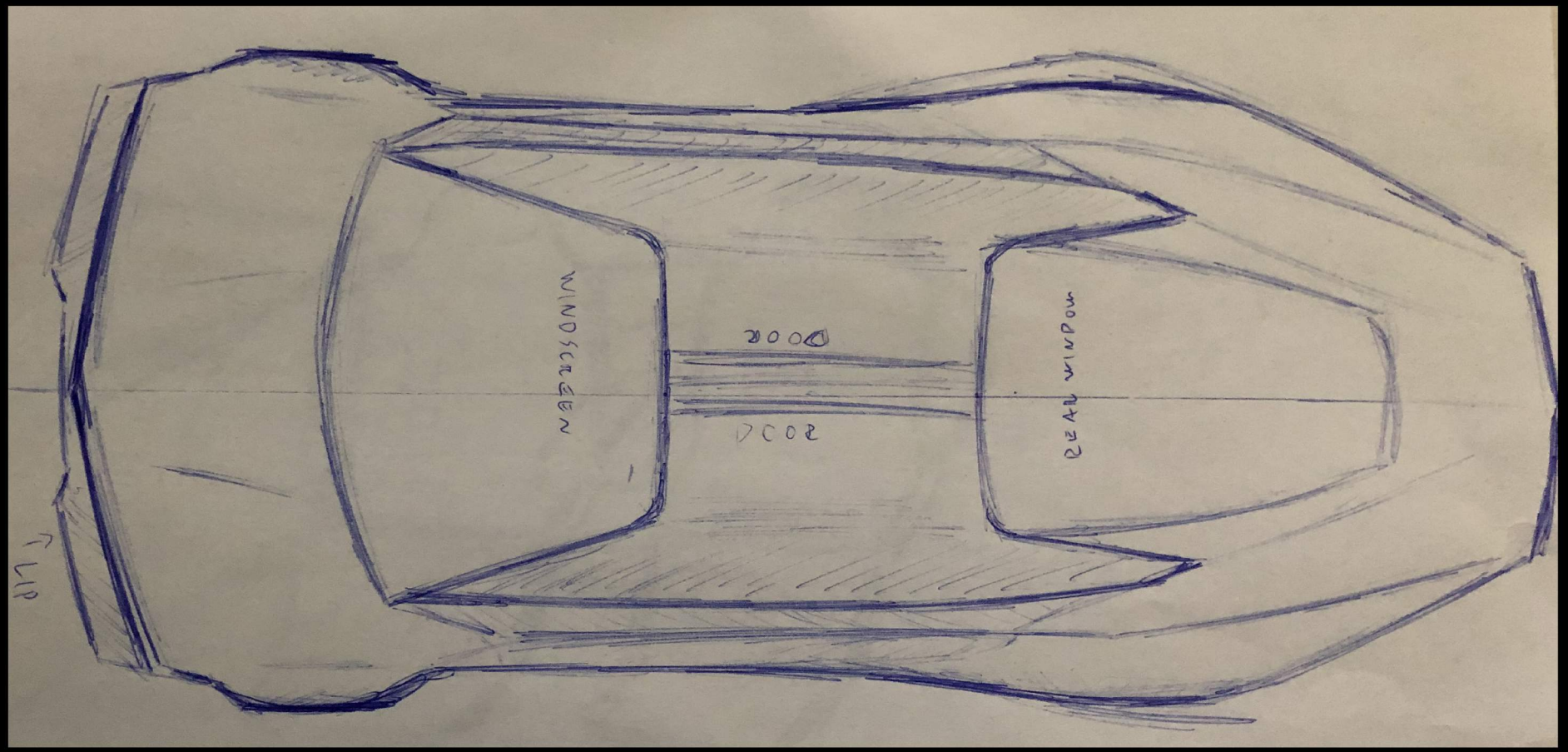


Rear

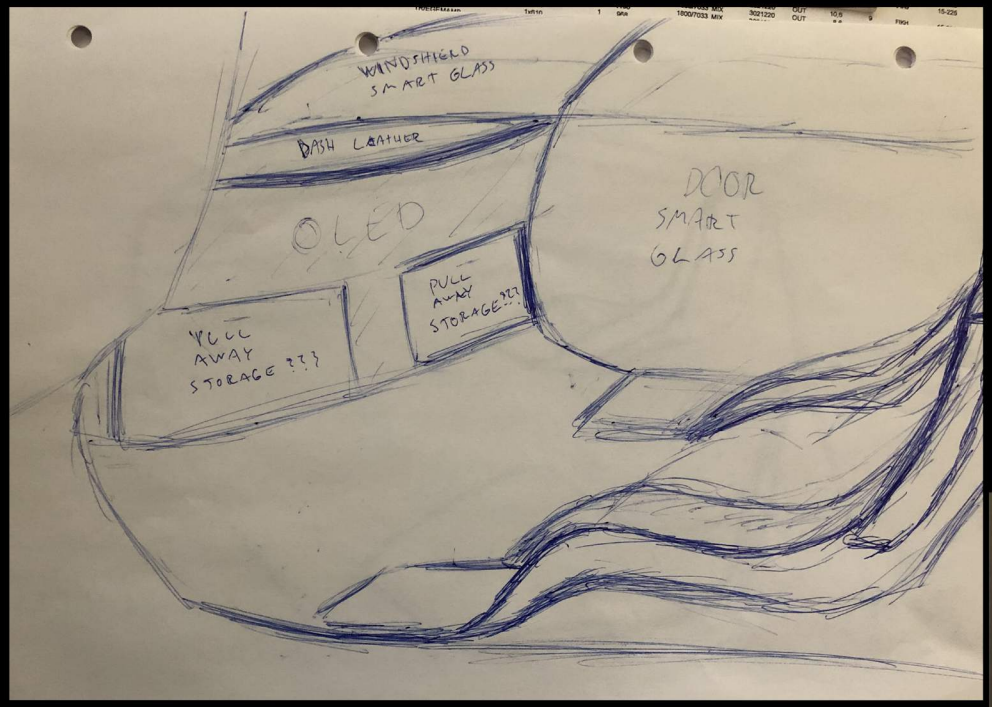


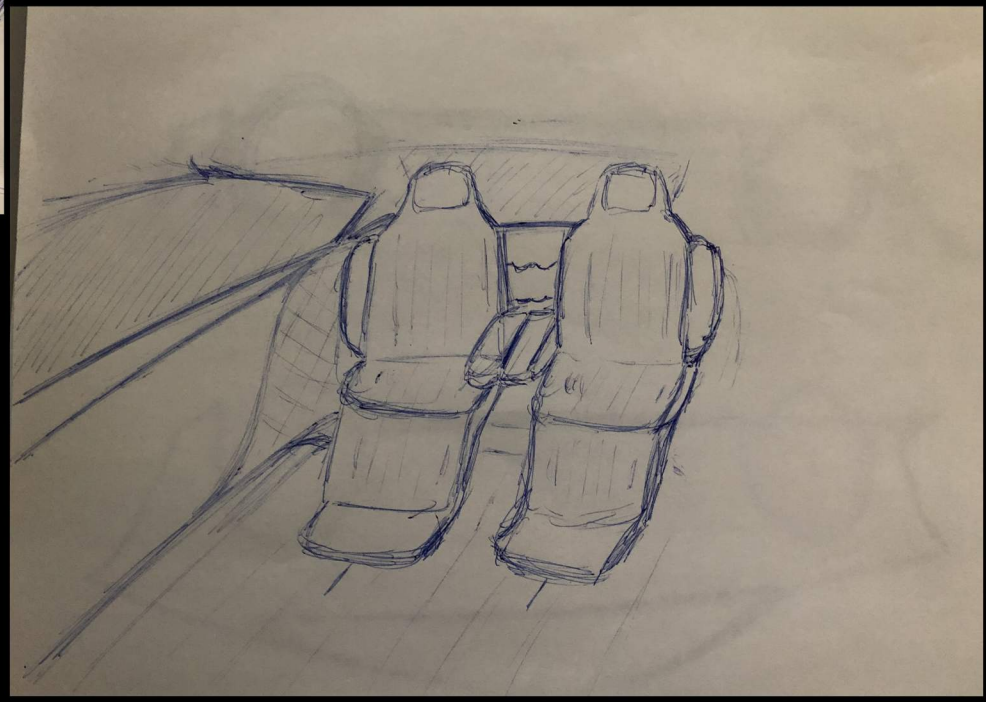


Top



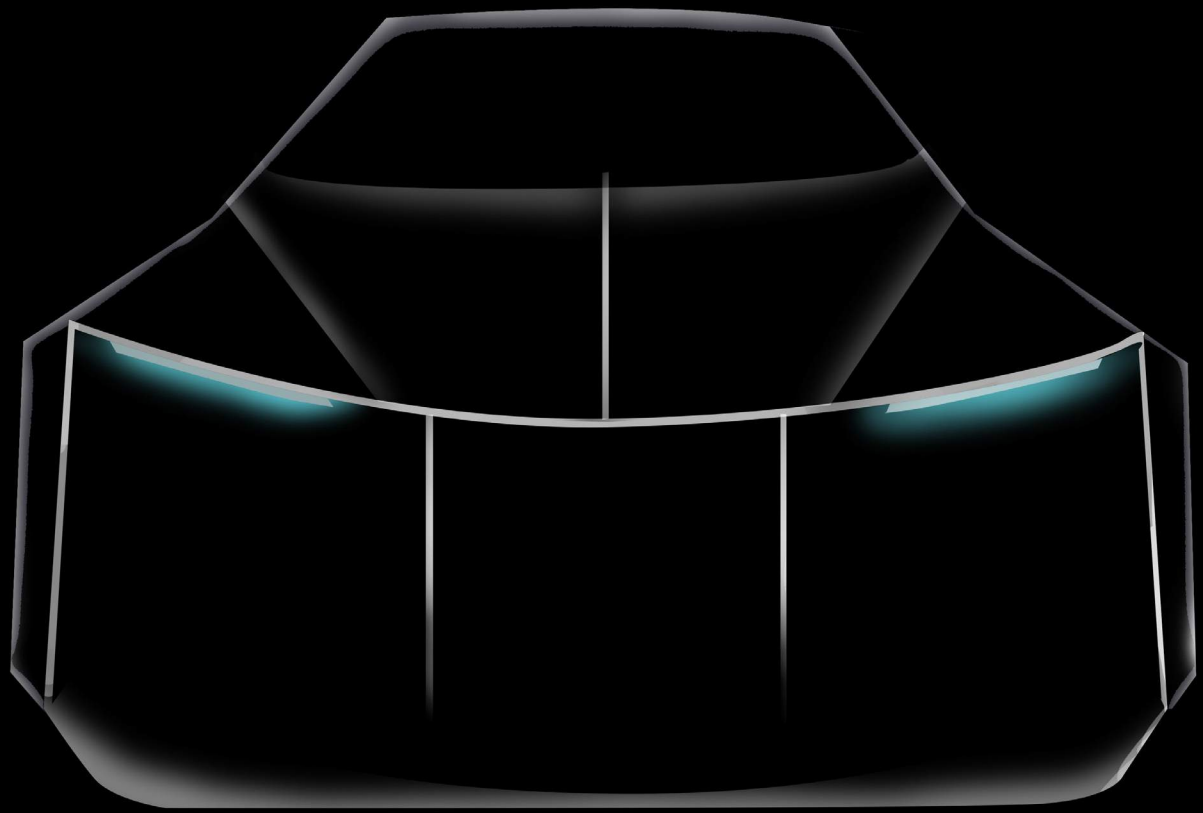
Interior

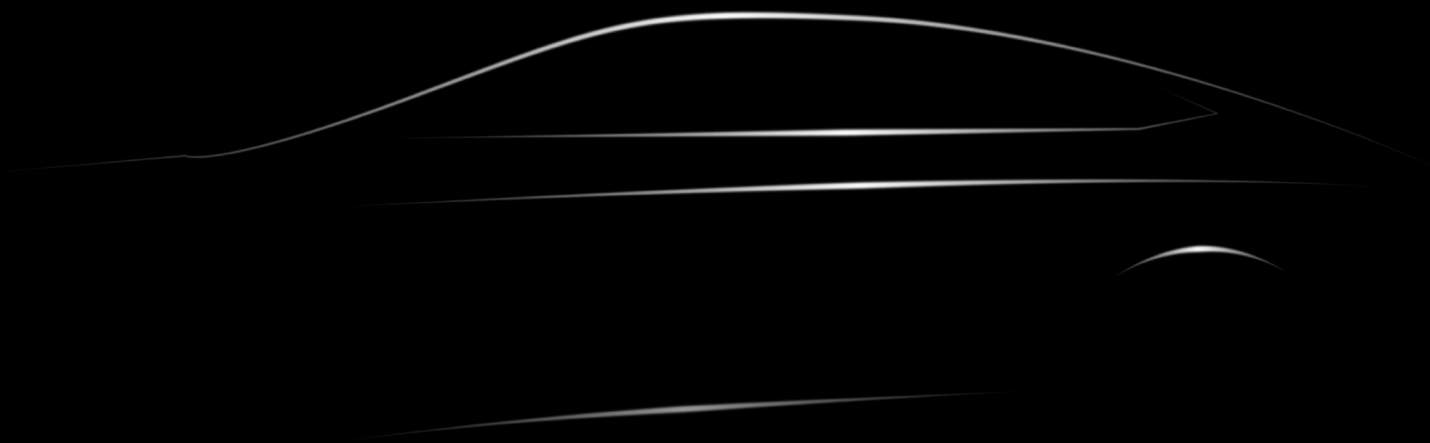

WINDSHIELD
SMART GLASS
DASH LEATHER
OLED
PULL
AWAY
STORAGE ???
PULL
AWAY
STORAGE???
DOOR
SMART
GLASS



5.2 Design cues

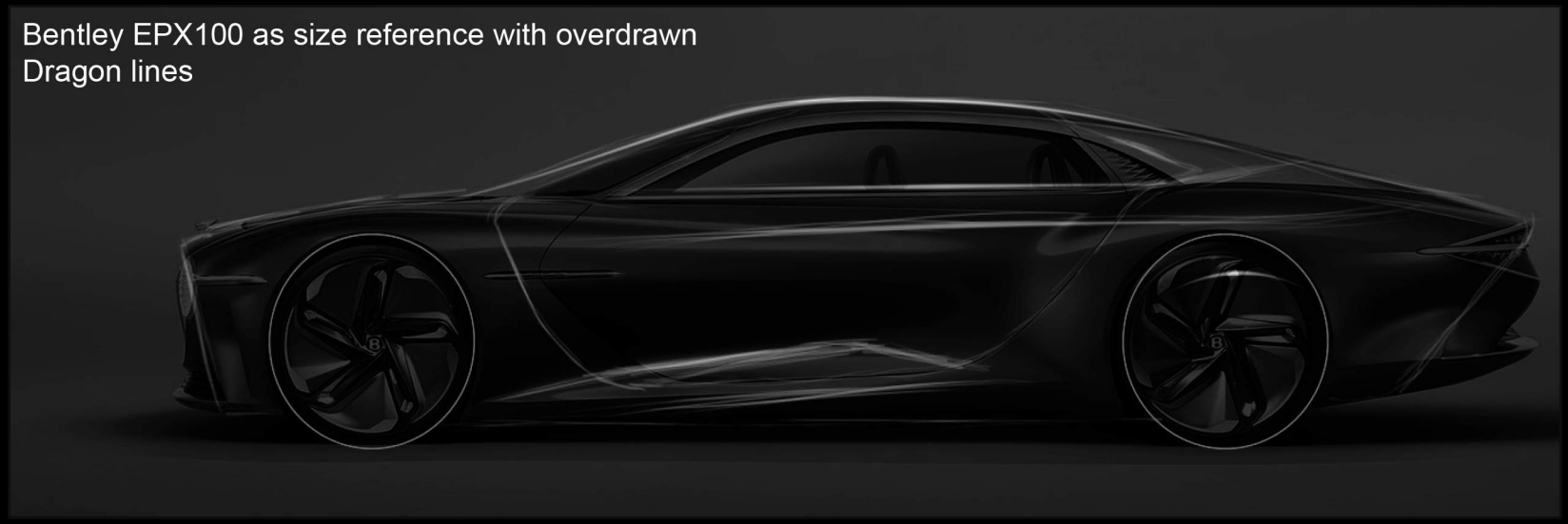
I kept exterior design of this car very simple. The front area of the vehicle is dominant with the rather aggresive looks, low ground clearance and sharp main lines.
On the sides of the vehicle I only used one main line from the front of the door to the rear of the vehicle. There are also shorter secondary lines to give sides some expression and shape.
On the rear end the sharp line separates the hollowed/ carved out rear bumper from the rest of the body. The sport version has a massive rear diffuser to give the rear really aggressive looks.
Interior has a main line that wraps around the cabin making it feel more connected and more solid. Seats have sporty looks. Exterior's design lines are also featured on the interior side of the doors.





5.3 3D-modeling

Modeling was a new tool for my design process. I used Blender for modeling. 3D model challenged some of my design ideas, and some ideas needed to be redesigned. The Bentley EPX 100 was used as size reference at some points.



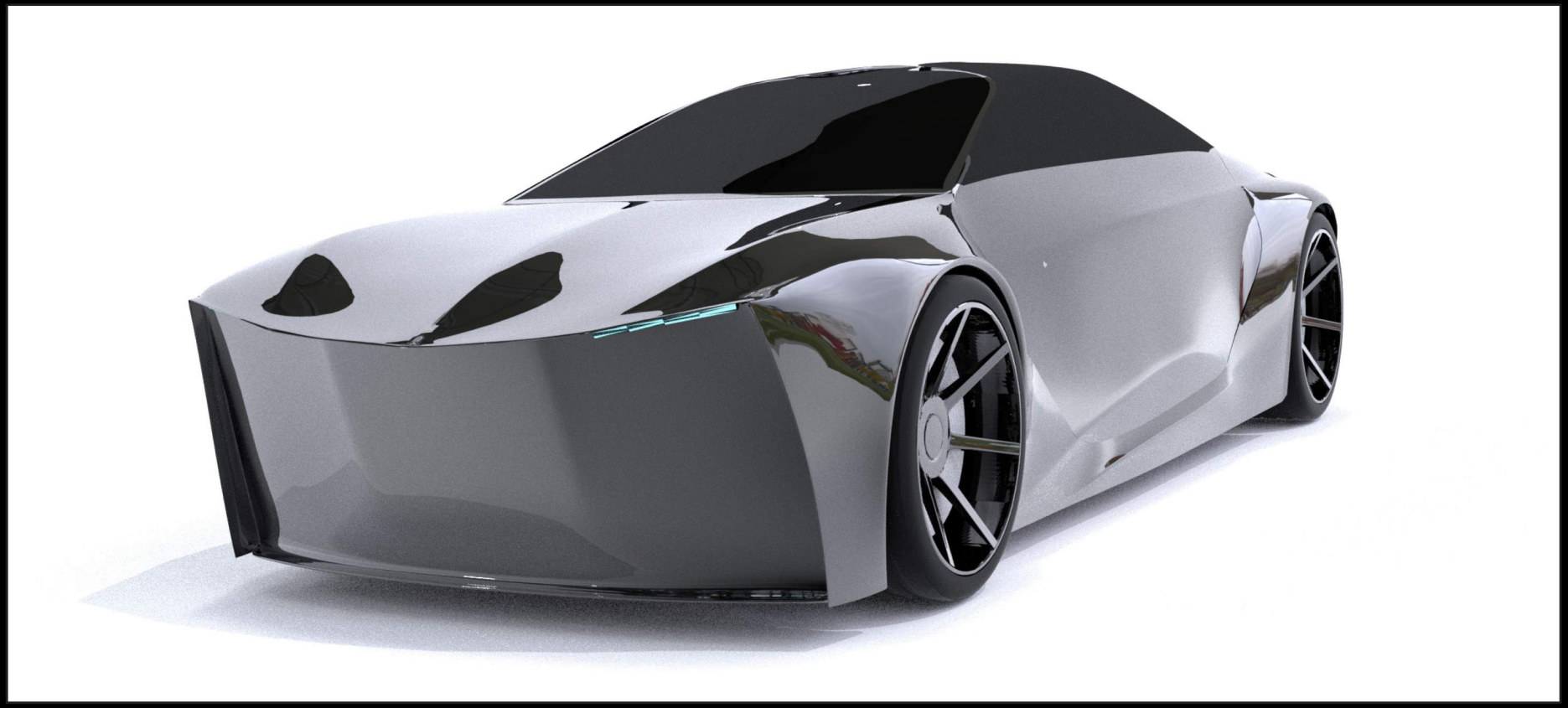
Bentley EPX100 as size reference with overdrawn Dragon lines

Carbon fiber body and smart glass doors
& roof can be seen here

5.4 Exterior

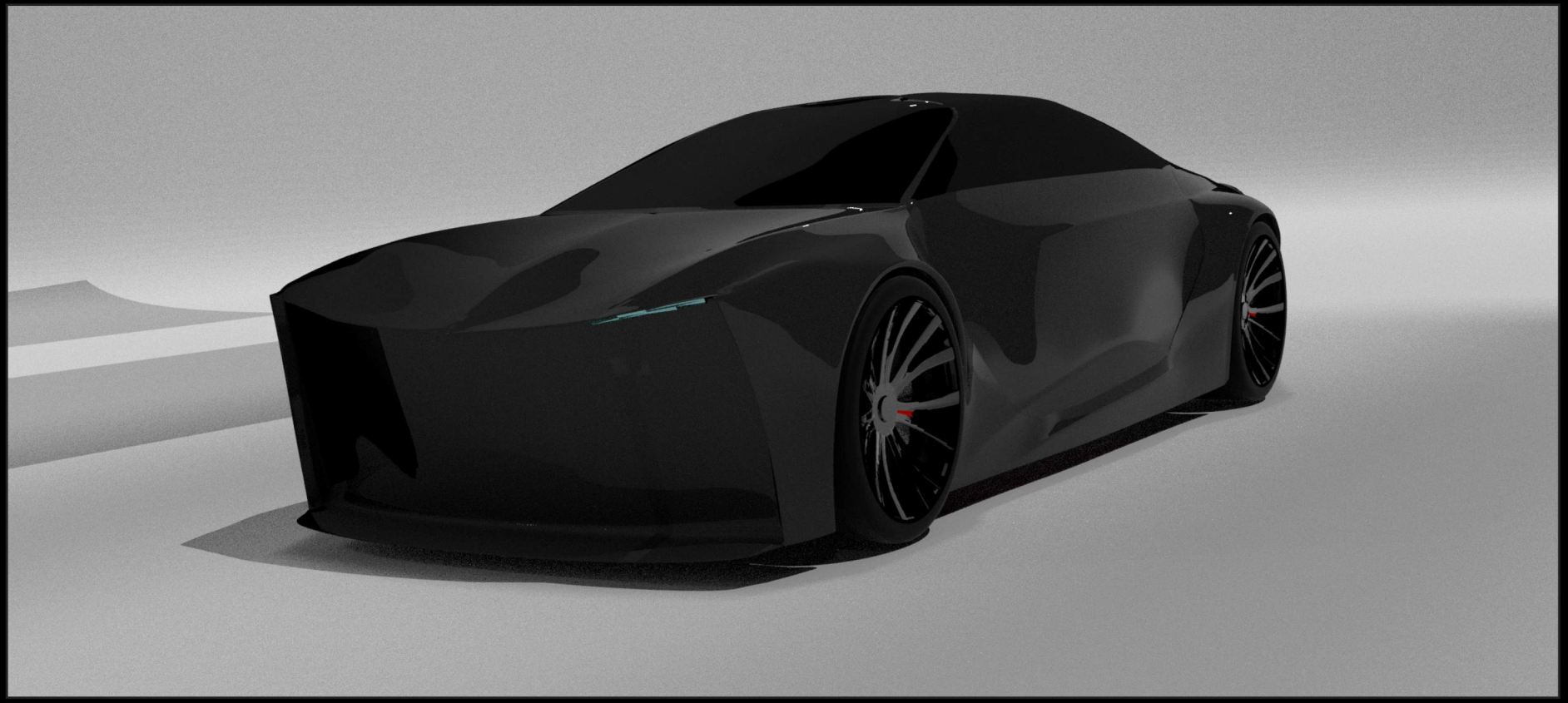
5.4.1 Conservative

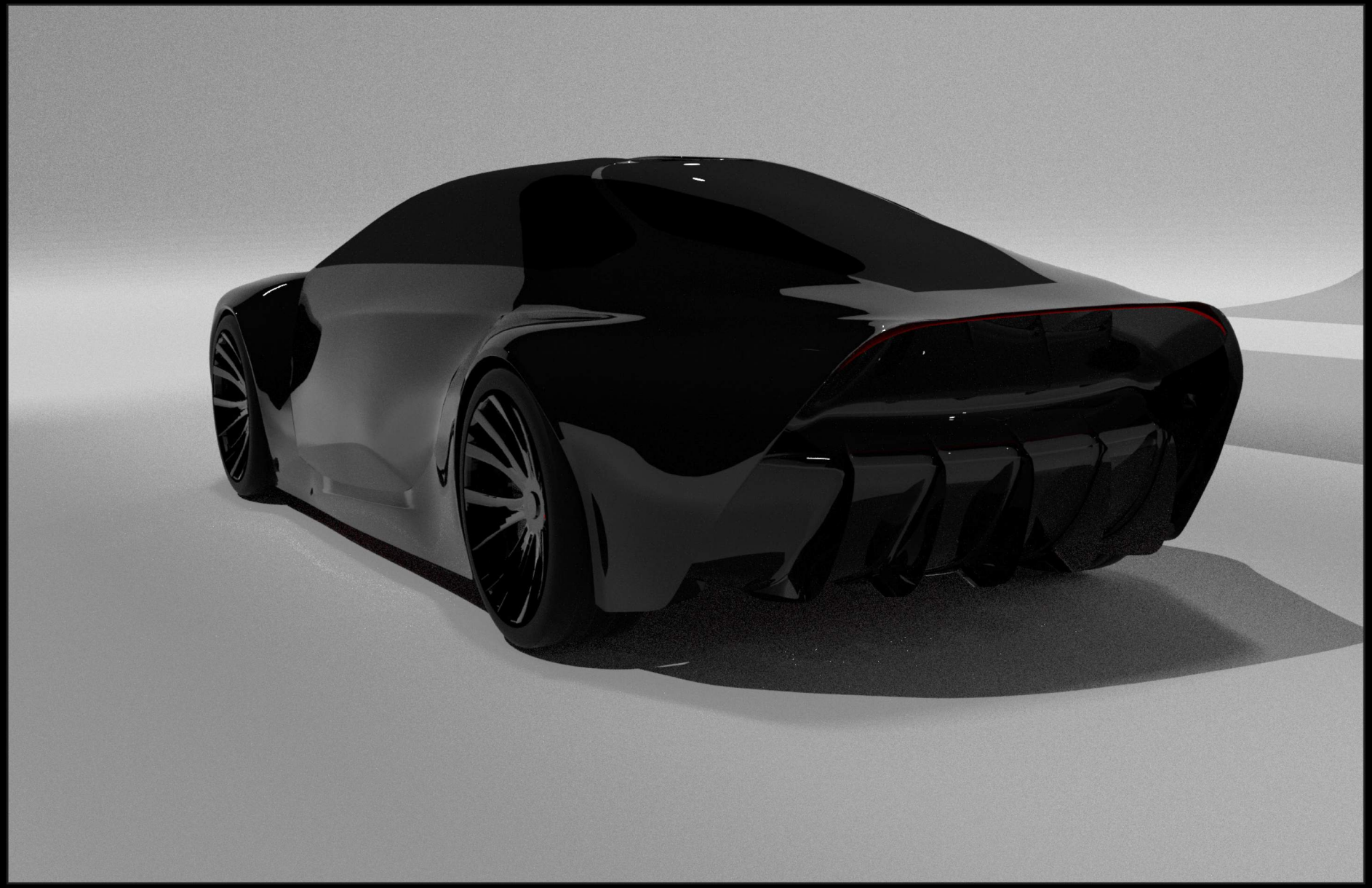
Conservative look has smaller front lip and it has no diffuser

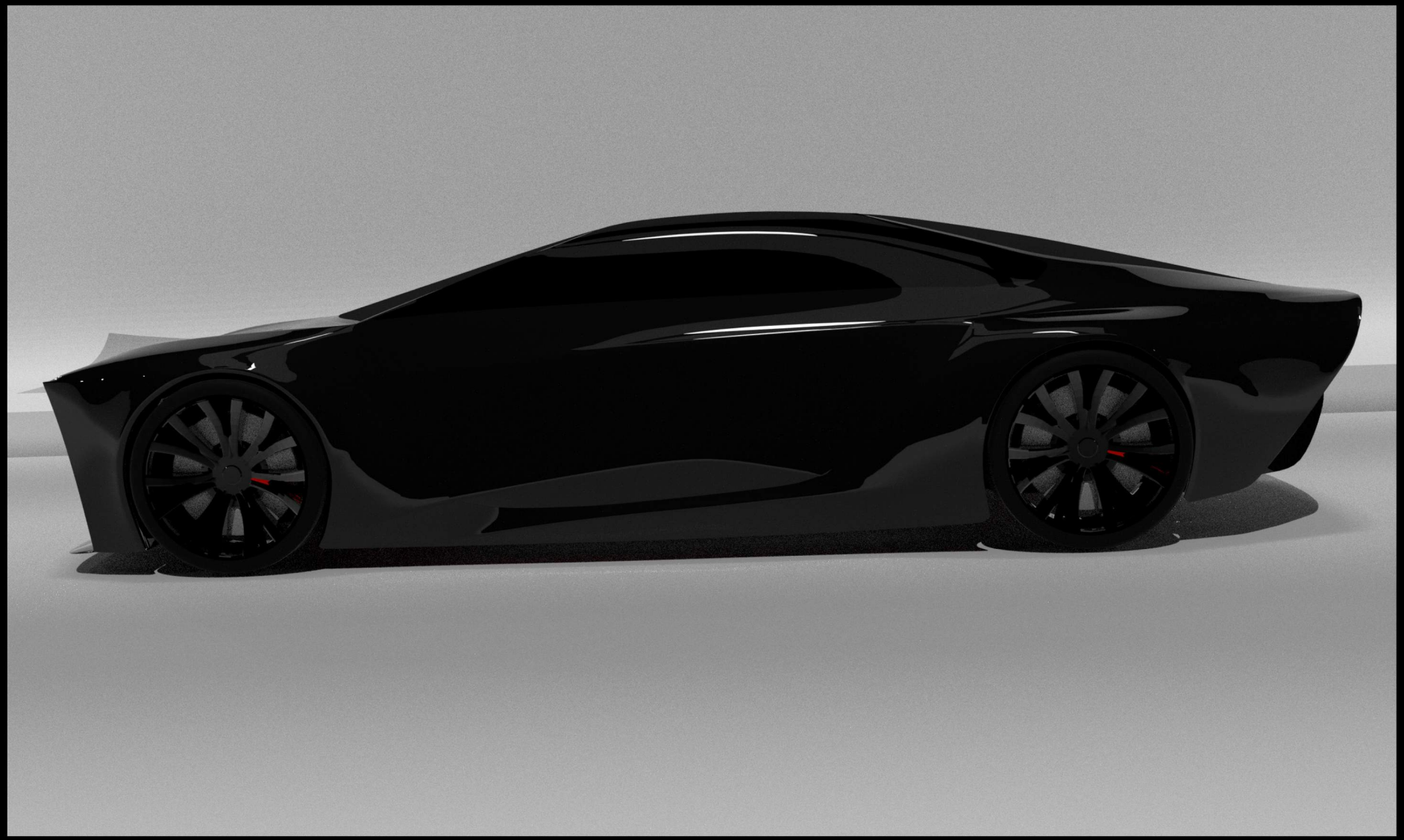


5.4.2 Sport

Sport look adds bigger and lower front lip and massive rear diffuser







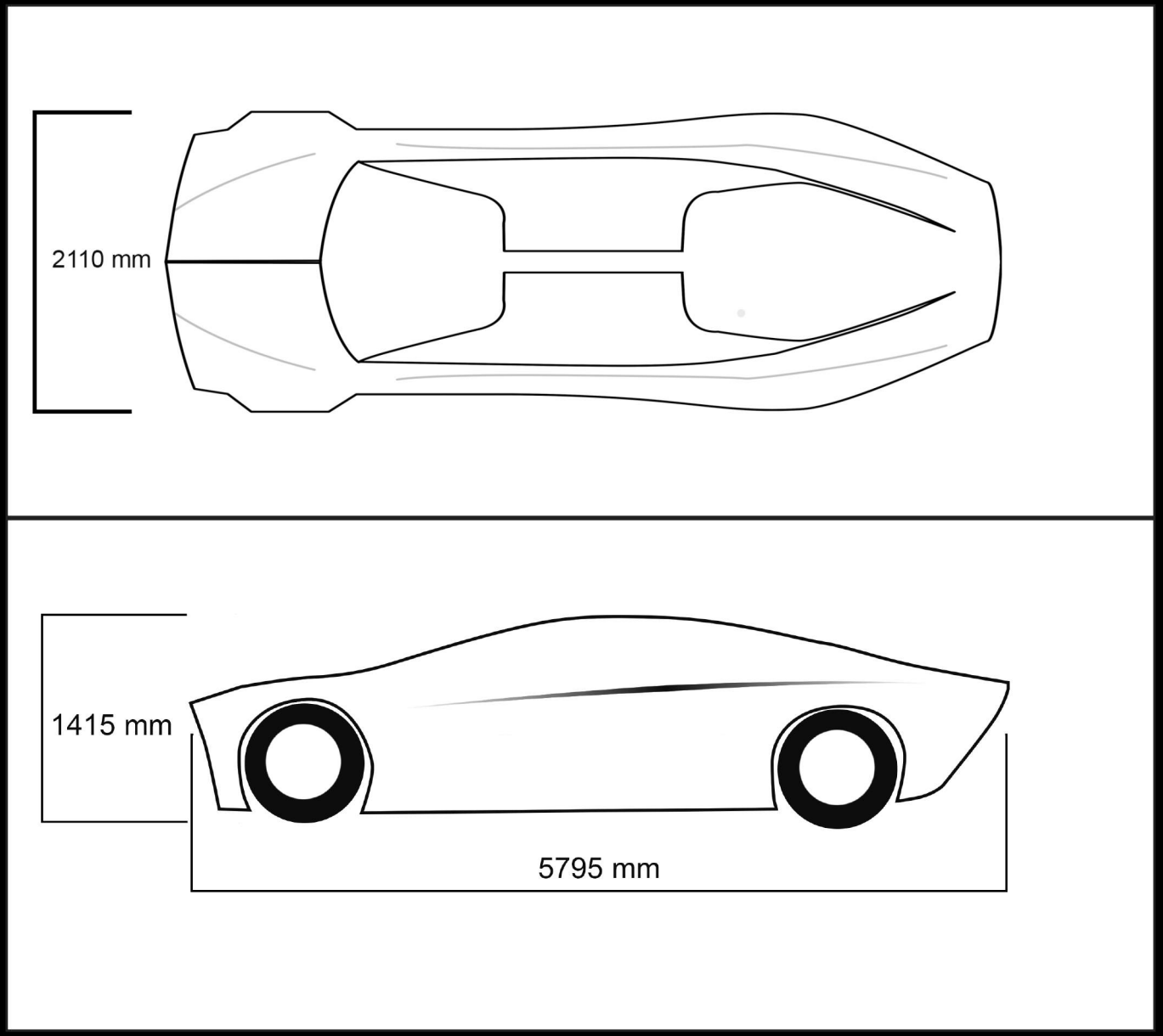
5.4.3 Smart glass incorporation

Smart glass is incorporated around the vehicle. The roof and doors are solely made out of smart glass.

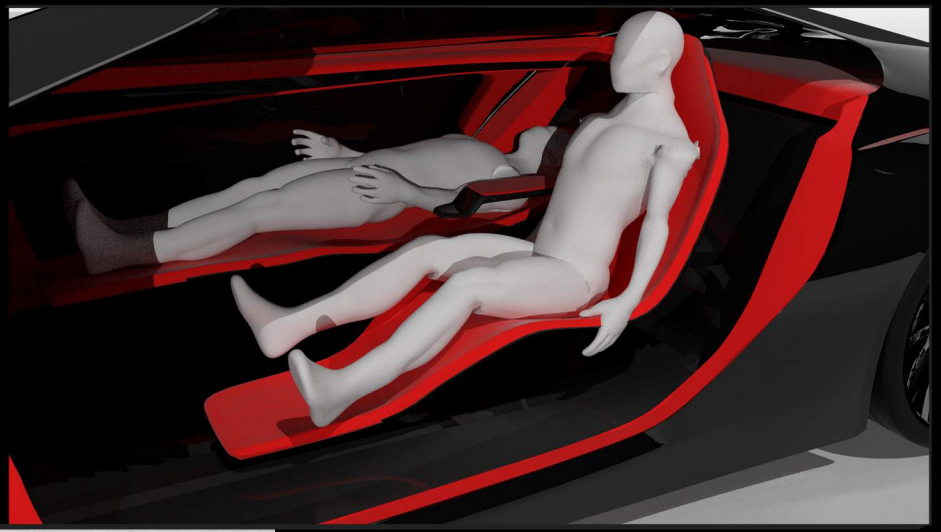
5.4.4 Livery and colors

Vehicle can have any desired livery and color. Dark color schemes are recommended for this vehicle.

Measurements:
Width: 2110mm
Height: 1415mm
Lenght: 5795mm



5.5 Interior



5.5.1 Layout & package

Layout of the vehicle includes seating for two persons with ability to move seats to the lying position.

5.5.2 Seats

The seats have sporty looks with ” alive carbon” back. The seats can move to any desired direction and are designed with comfort as number one.

5.5.3 Smart glass & OLED touchscreens

The interior is surrounded by screens. Doors and the roof are smart glass displays, whereas ” dashboard” and interior panels include OLED touchscreens.

5.5.4 Materials & colors

Consumer can choose any material desired for the interior. High quality leather is recommended for seats and silk or leather for other various interior panels that consumer opts to be upholstered. Carbon fiber and precious metals are suggested for highlights.

6. Final design

Final spec DÆRK DRAGON red sport

- 2-seater autonomous luxury GT
- Hydrogen fuel cell electric vehicle with inductive charging cabability
- 4 electric motors, one for each wheel
- Carbon fiber body, smart glass display doors & roof
- Glossy black exterior paint with red highlight striping
- Red leather interior with carbon fiber

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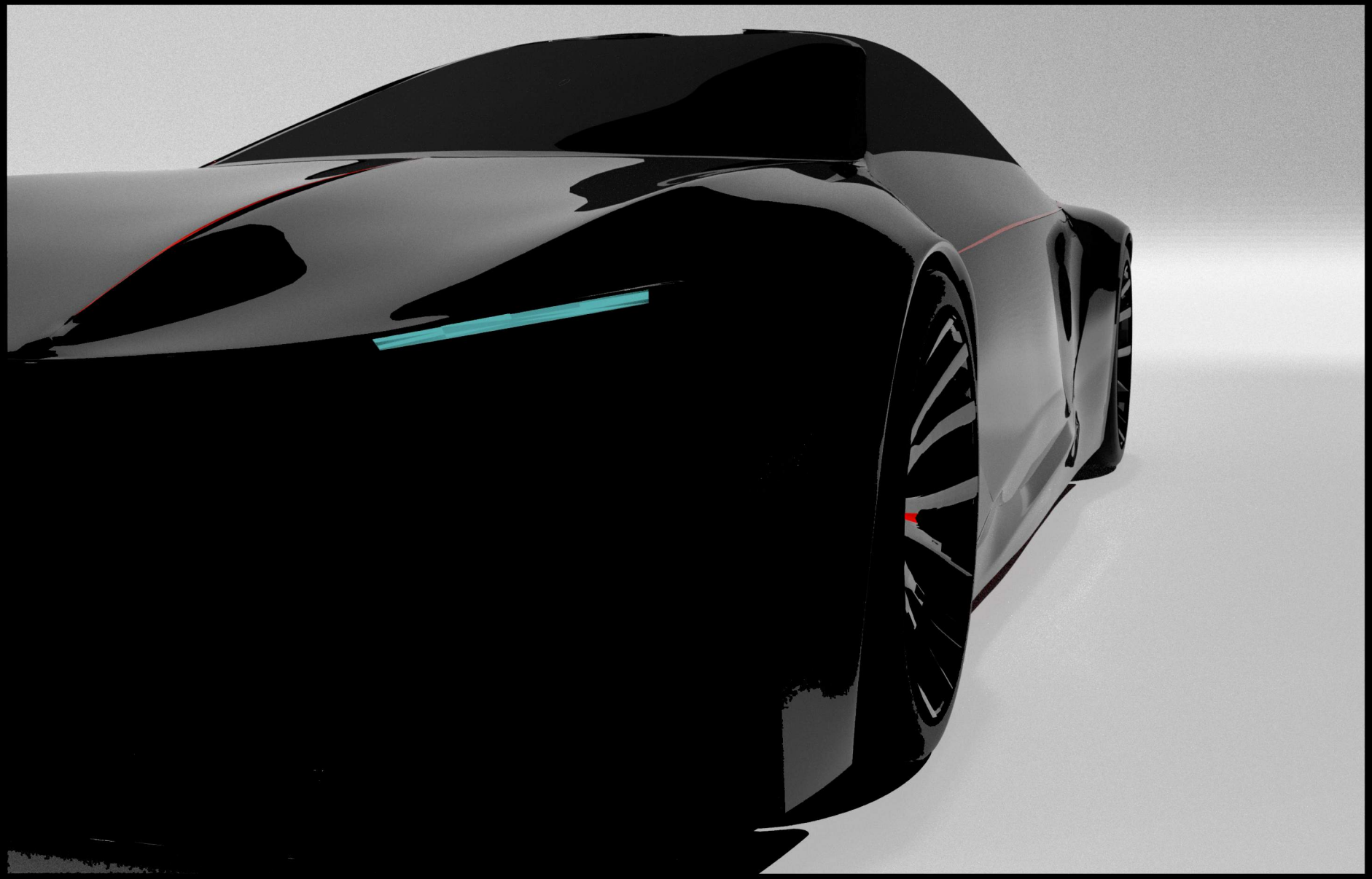
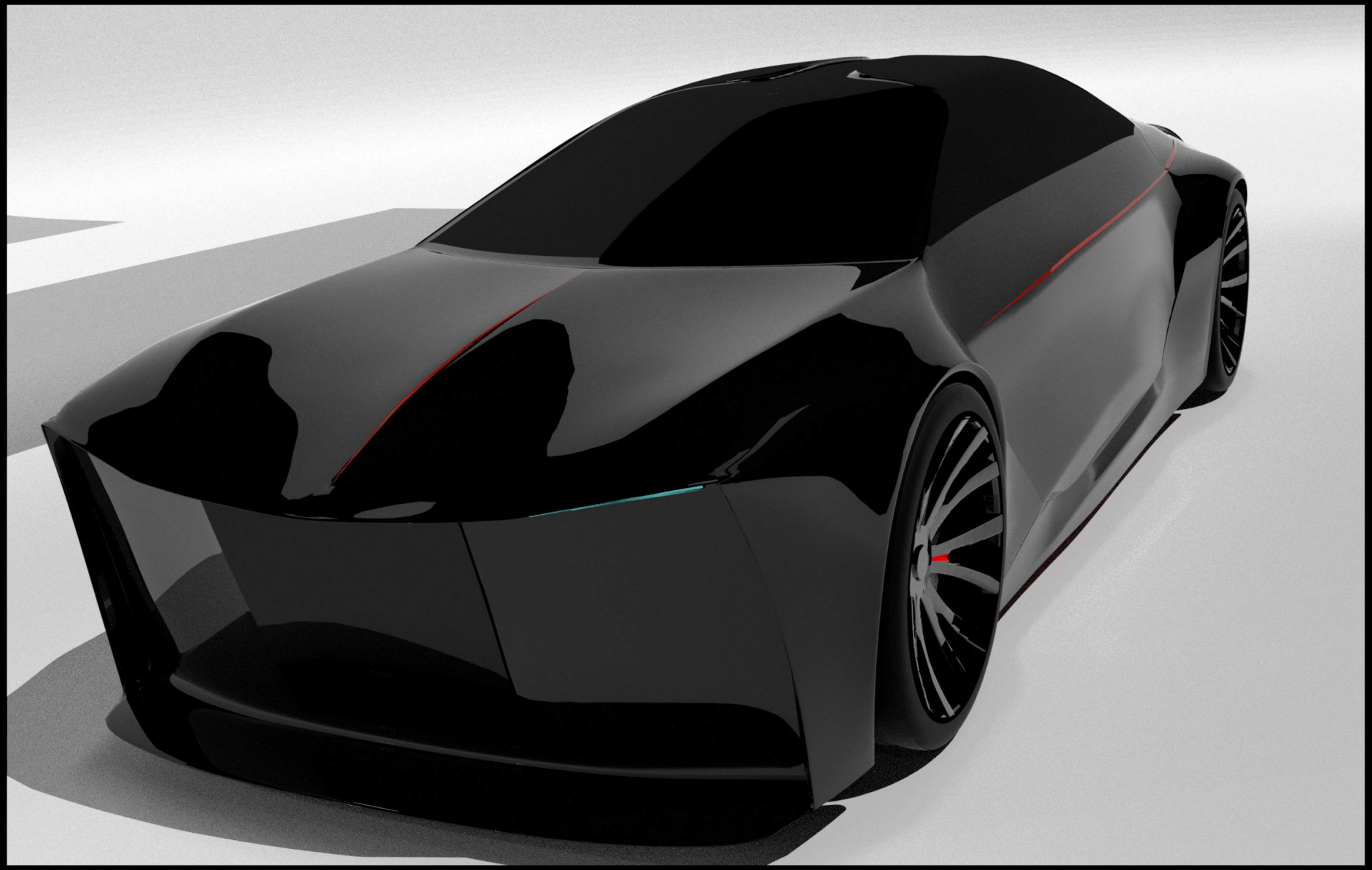
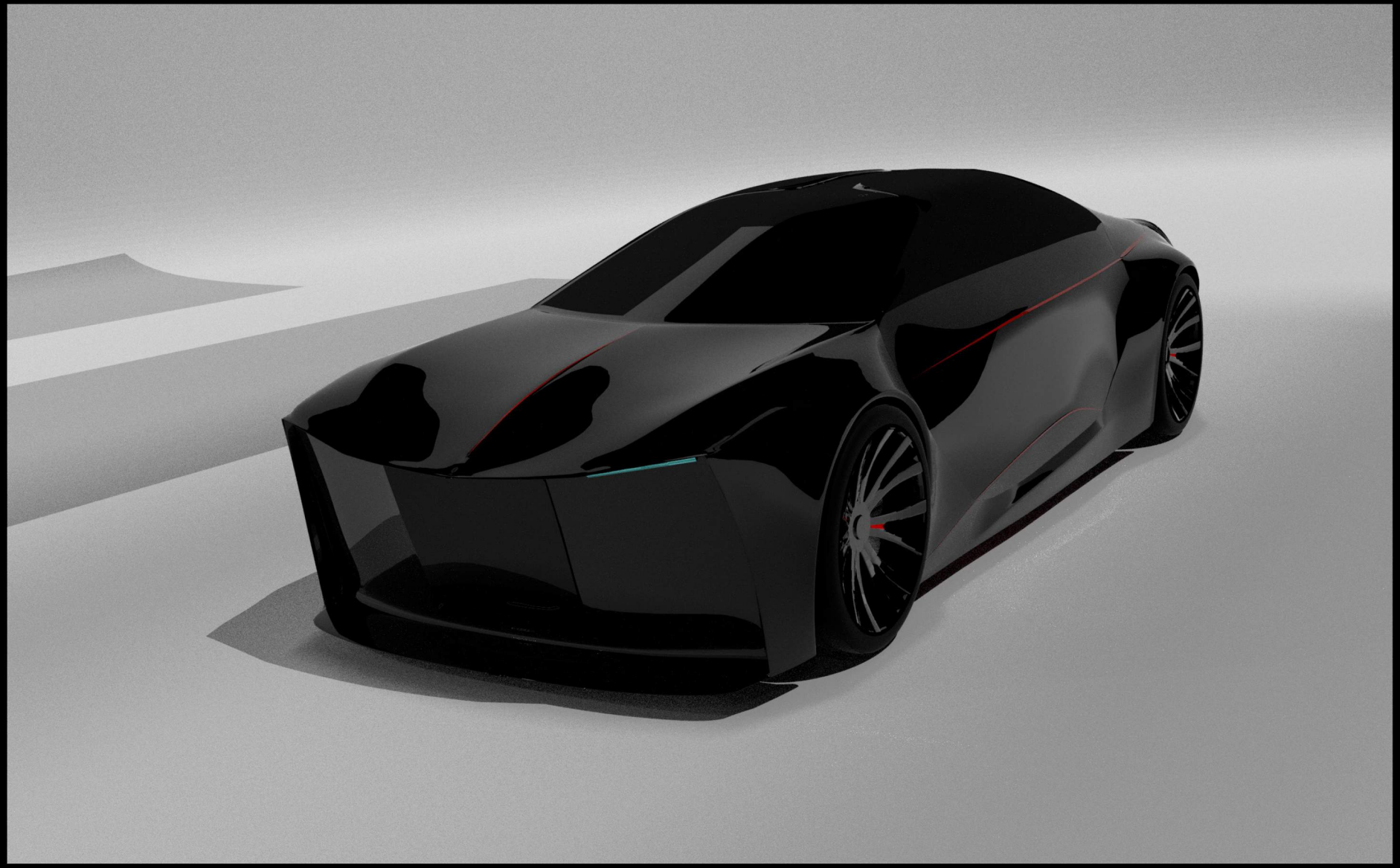
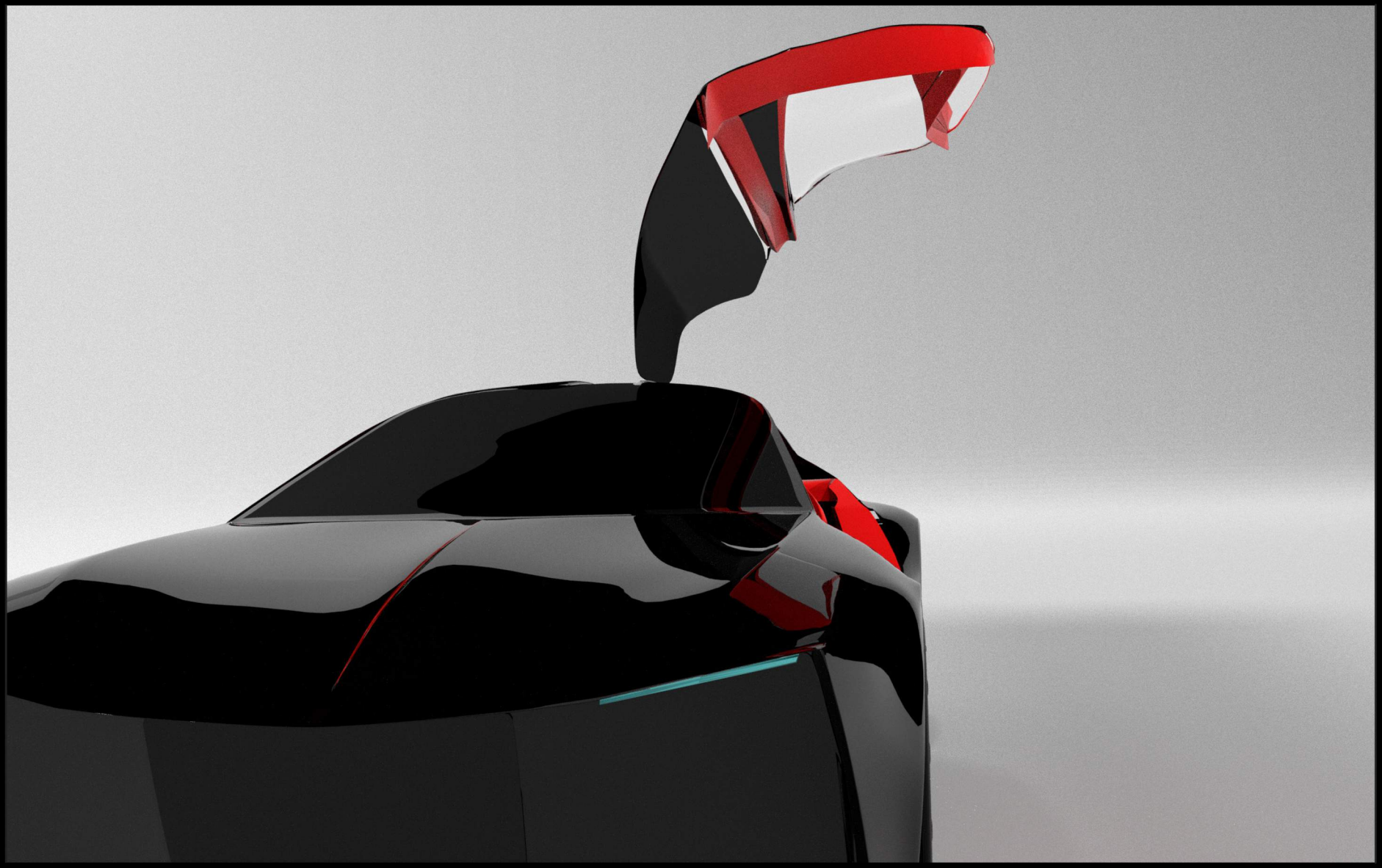
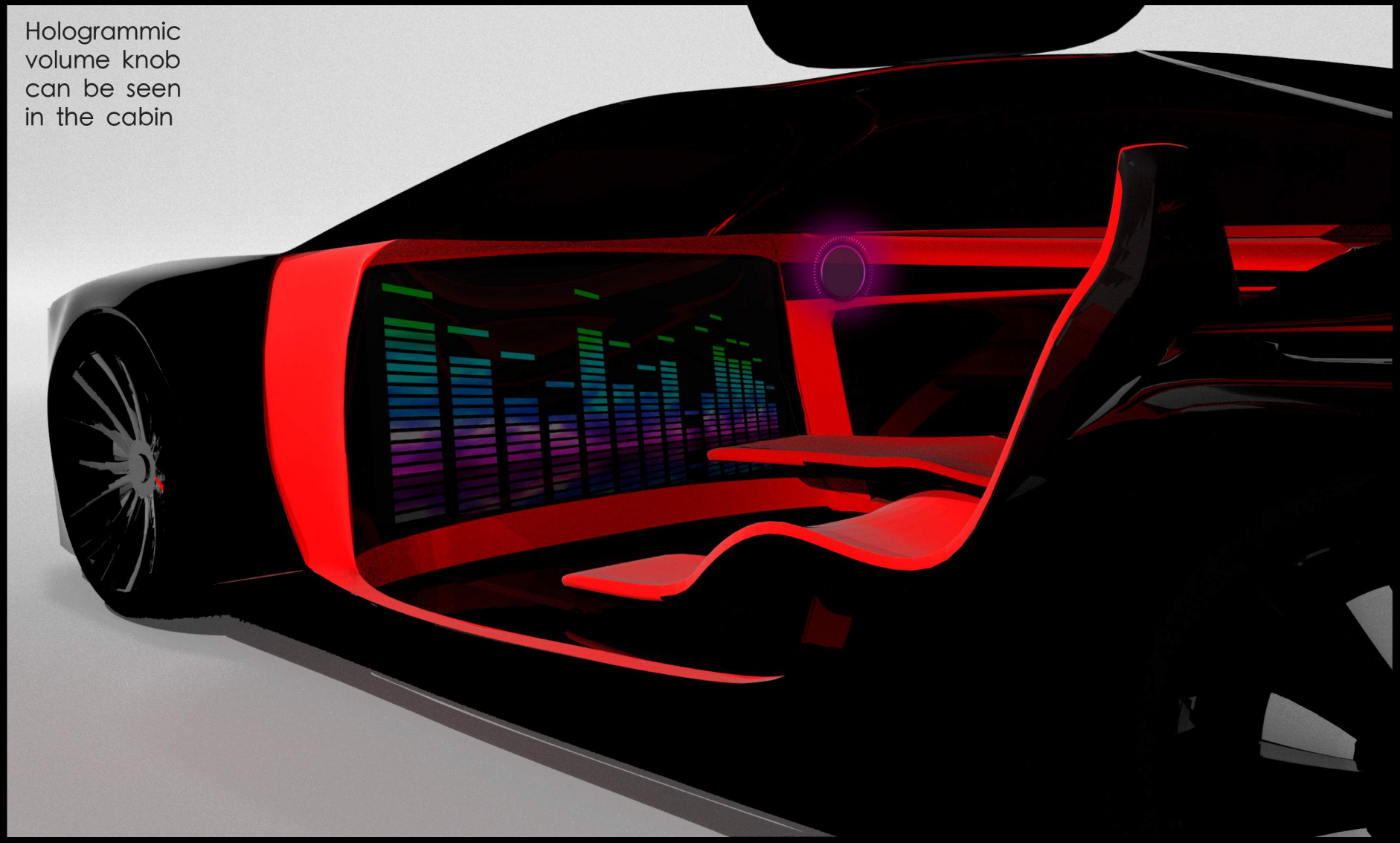








Hologrammic volume knob can be seen in the cabin

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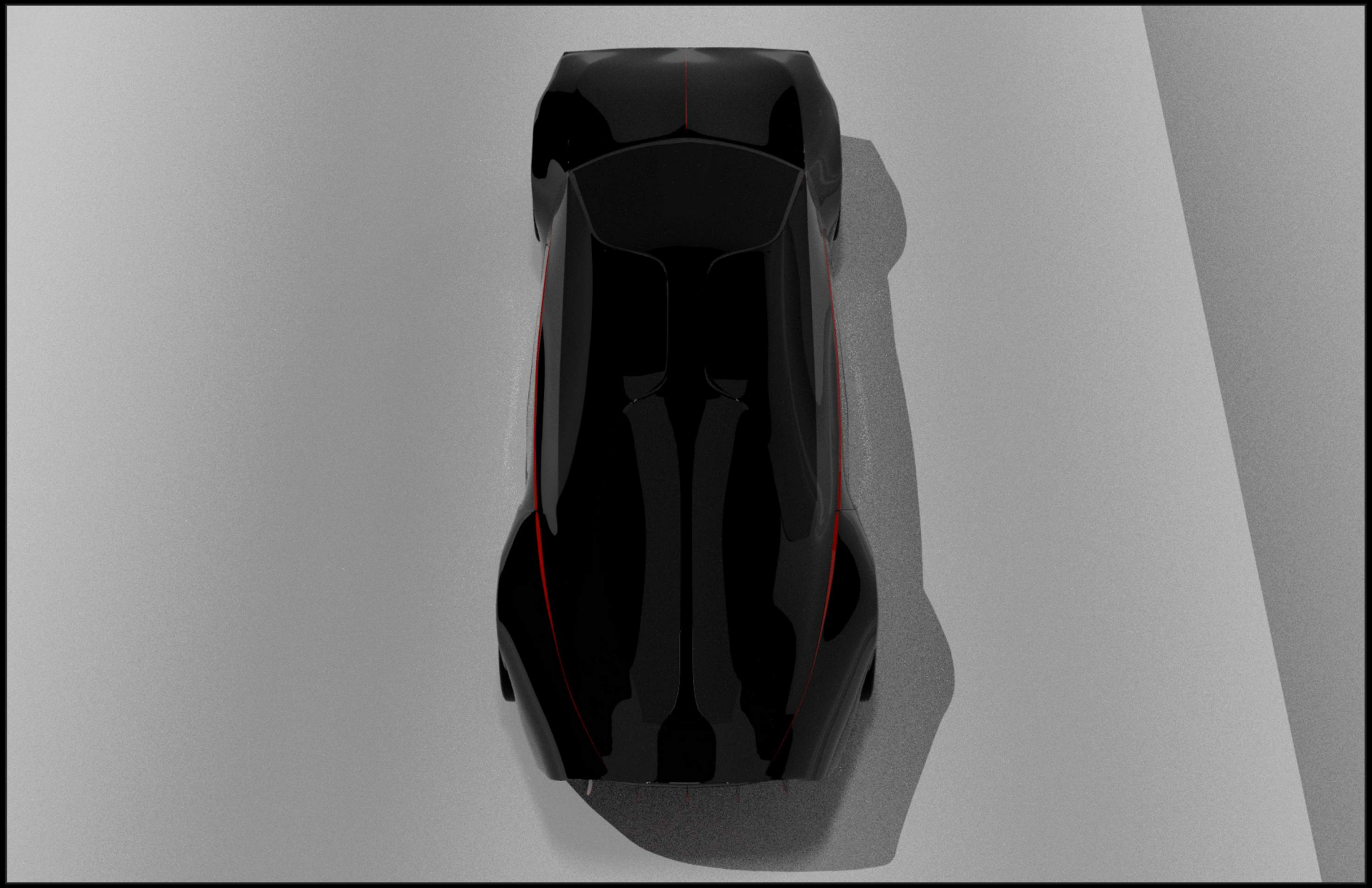

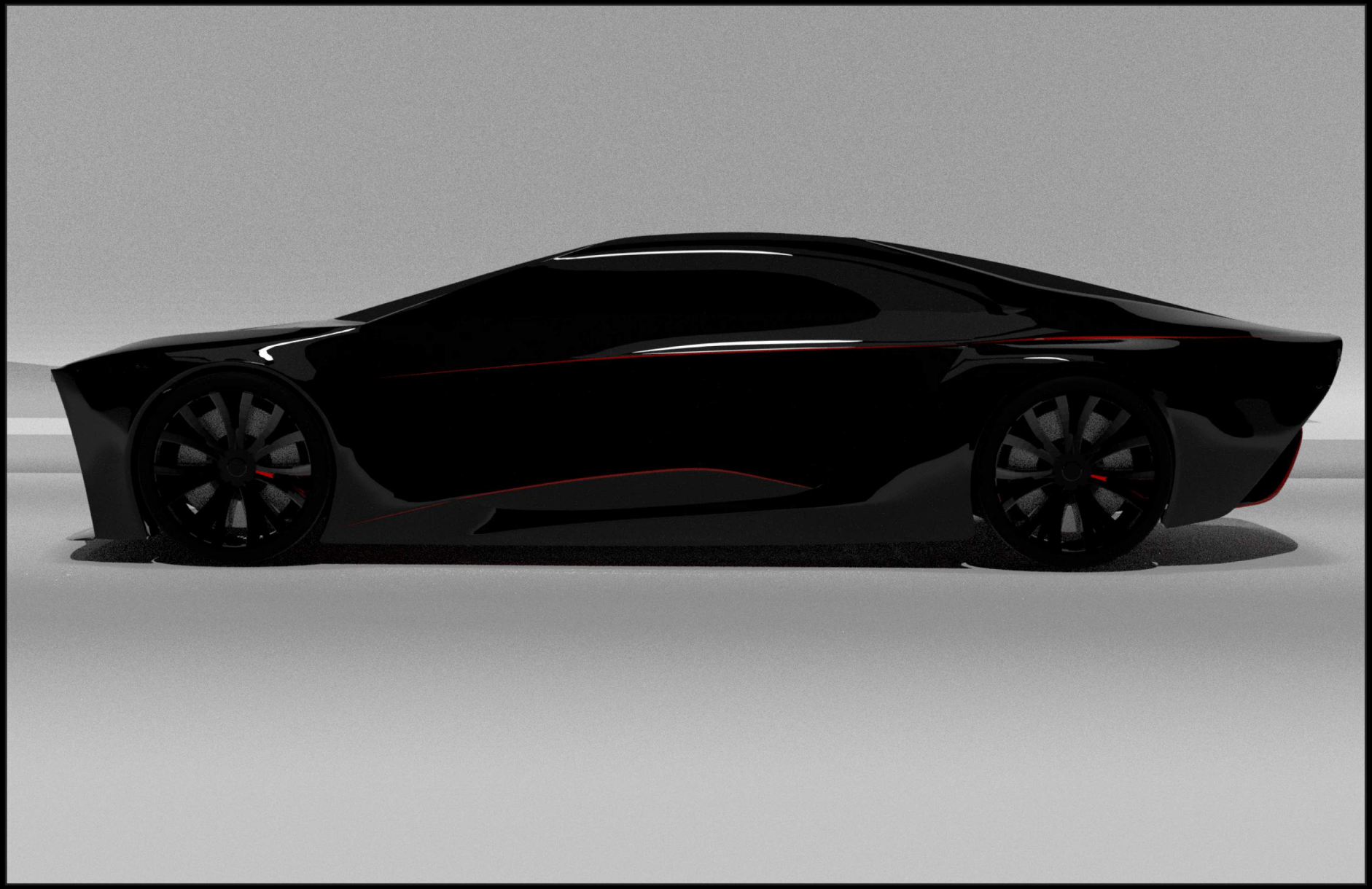

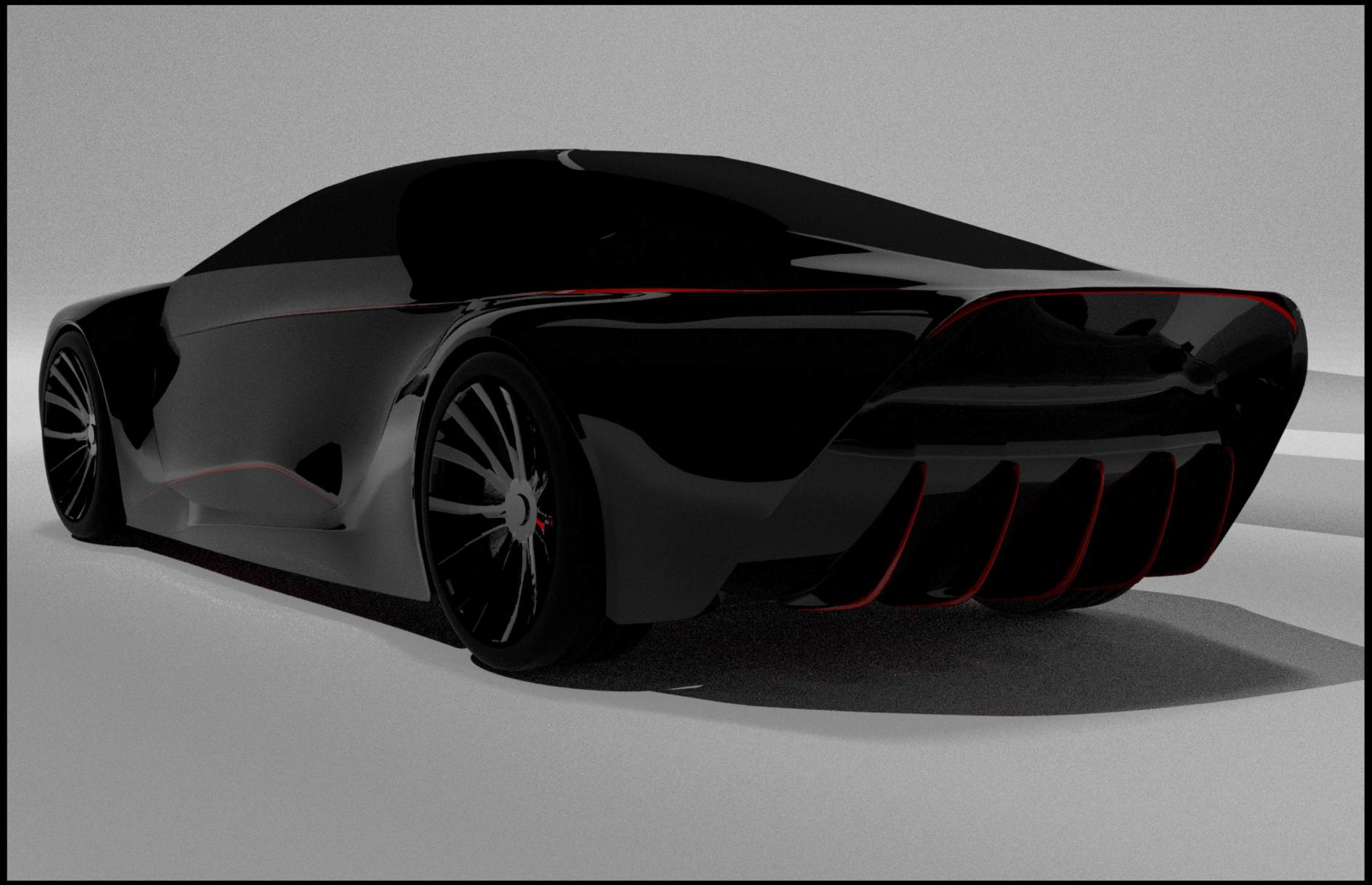

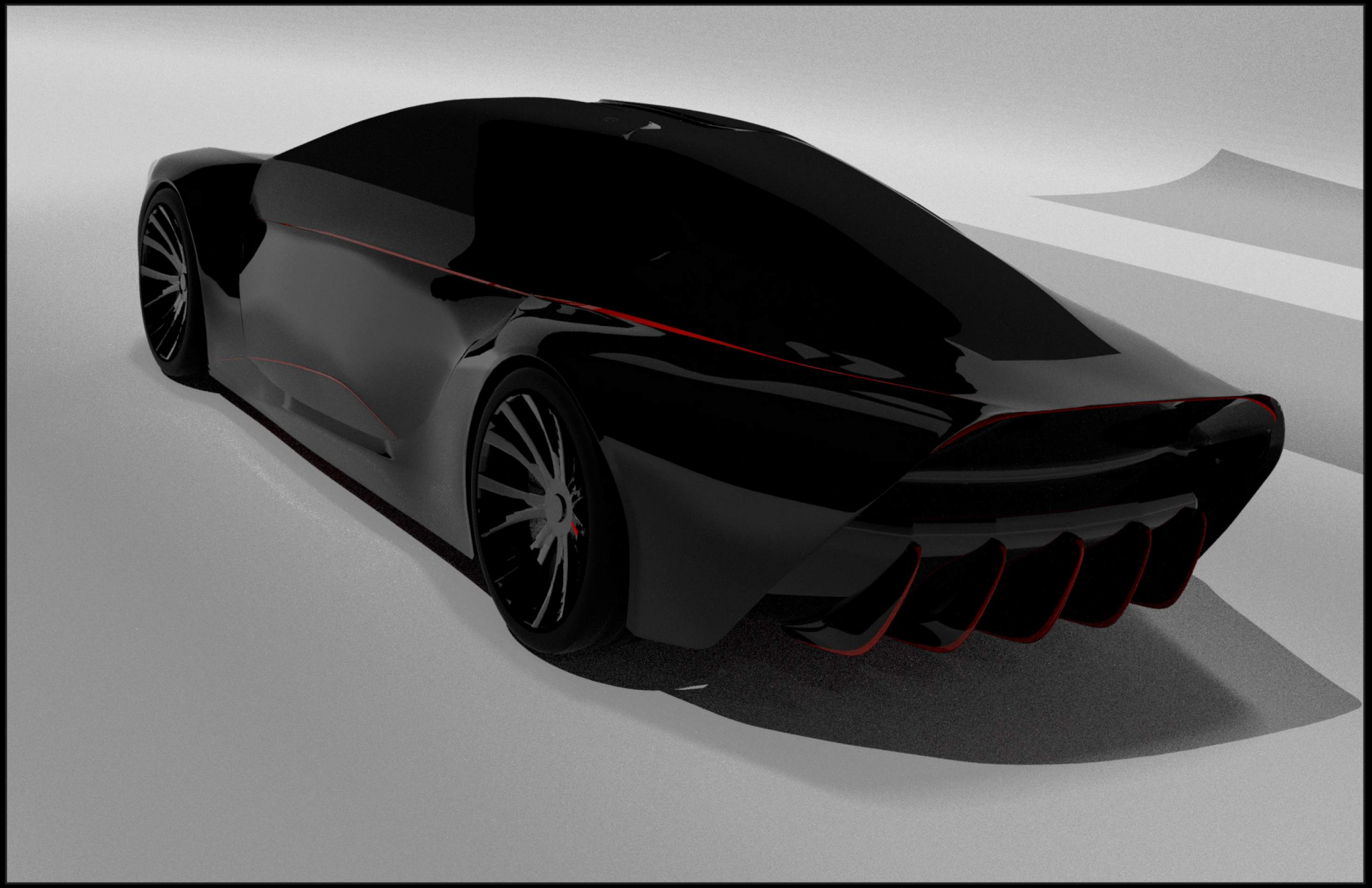

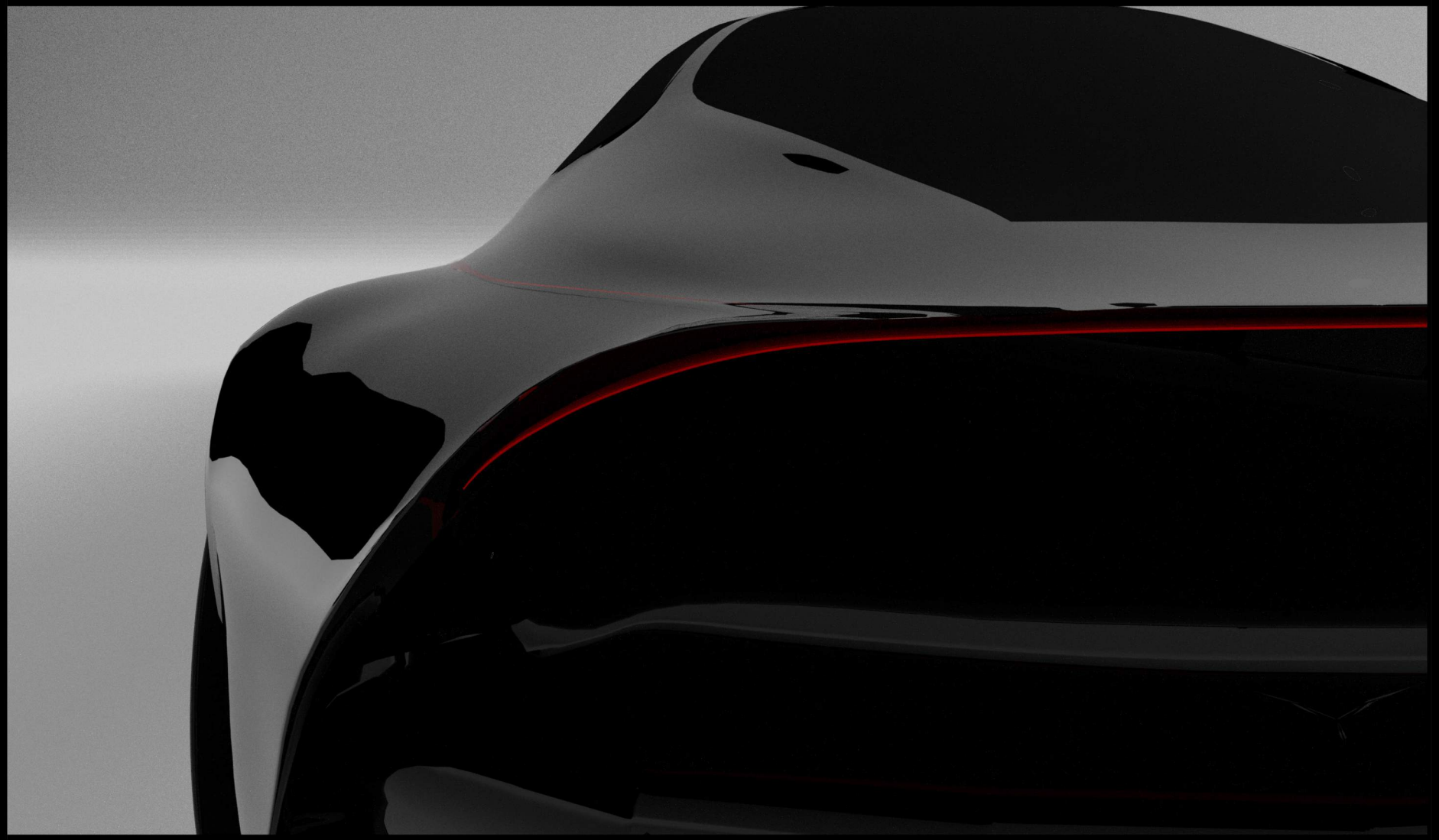

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7. Self evaluation

The whole process was long and hard. My full time job took a lot of energy from this project but I still managed to get it done.

I had pretty much zero experience in modeling before this project so that took a lot of work and hours. In the end the product is pretty close to what I wanted to design. There is always room for improvement and I would do couple things differently next time. Overall project was fun to make and I would say that I am moderately pleased with it. The project took easily over the 400 hours that were opted for this.

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