1) When you create/produce a medical device you have to perform certain tests. Where can you look up which tests to perform?

-> Biomaterial Compatibility Matrix! Overview what it looks like, things you must take into consideration (e.g. time of application, application method, etc., effects like carcinogenicity...).

What does ISO stand for?

2) What should you check in the process of manufacturing before implanting an implant?

-> Sterility. Different methods of sterilization -> two examples, how they work, pros & cons.

Example: Polymer, melting point at 60°C. What method could you use to sterilize? -> Gas: EO (Ethylene oxide). Pros, cons, etc. How can you remove the gas afterwards? Vacuum.

3) Three important functions of the packaging of a biomedical device.

4) Tensile curve. What are the axes? Different parameters, 0.2% yield etc.

5) The tensile curve I drew was typical for a metal (which can deform plastically). Are there materials that cannot deform plastically at all?

-> Ceramics. ...

Why is there no plastic deformation?

-> Metal: Electron gas & metal bonds...

Ceramics: covalent bonds between metal and non-metal and ion bonds...

Do you know any other bonds?

6) Biodegradability. Examples for biodegradable polymers & how do they biodegrade?

Mine were:

1) All sterilization methods with a short explanation

2) Photopolymerization

3) Titanium (advantages, disadvantages), Why is it so biocompatible?

4) Classes of medical devices

5) Wound healing stages

Biocompatible materials (27.01.2020)

There might be a question missing

1) There is a drawing of a cubic face centered unit. Calculate volume ratio (volume of spheres over volume of the cube)

2) How can materials be classified depending on their bonds ? How can they be classified depending on their structure ?

3) What is a ceramic ? A glass ? A glass ceramic ?

4) What are the advantages and disadvantages of ceramic in dental applications ?

5) What are the typical bonds within and between polymers ? Why is the melting point of thermoplastics low ?

6) Why is the thermal expansion of low melting material higher than for high melting materials ? Explain by drawing the energy vs atom distance curve of both materials.

7) What is the strenghtening mechanism in tetragonal zirconium? Why does it make it stronger and tougher ?

Draw a typical stress strain curve. Show how elastic modulus, tensile strength, 0.2% yield strength and final elongation can be found.

9) What are the information contained in a biocompatibility matrix ?

10) What are the four stages of wound healing ? How can wound dressing help with wound healing ?

11) What are the difference between long bone fracture healing and cranial fracture healing ?

[308.106] Biocompatible Materials exam 2.9.2020

Define ceramics, application, disadvantages

the four states of wound healing , what wound dressings exist and what should they do (explain one specific)

EO sterilization

transformation strengthening of zirconia

in vitro testing of a biomaterial (direct contact, indirect contact and extract test)

Questions for the oral exam today:

-pyrogenic: what does it mean, name tests to check for pyrogenic material

-foreign body reaction: different stages, how can we in fluence the foreign body reaction

-metals: definition, lattice structure and name an example material and application, what is a problem when using a metal as an implant

-polymers: definition, classify them in terms of morphology, why are thermoplasts soluble, what happens when heating up polymers, name a biodegradable polymer

-stents: what materials can be used, how can we avoid restenosis, what is the latest generation of stents

Oral exam today:

\*) Classes of BD

\*) ceramics: properties, difference to glasses, glass ceramics

\*) zirconia: transformation strengthening

\*) define strength, stiffness, etc + parameters for each (Youngs, yield strength, ...)

\*) sterility: what is it? SAL, name all sterilisation methods, In detail: steam and dry heat (mechanism,pros, cons, which materials)

My questions were:

1) Classification of MD

2) Stress shielding

3) explanation of metal ductility

4) strengthening of metals

5) superelasticity (nitinol)

6) glass ceramics and glass (difference)

Apart from the usual questions I was asked:

•what is the proces of making a hydrogel

•describe the proces od 3D printing of ceramics

Mine were:

1) Classification of Medical Devices (all of the with details, risks and examples) what happens if a knee prosthetic fails?

2) Stress shielding (do the calculations for the loads) what is it? Which laws describe it? Why does it happen?

3) Zirconia. What induces the transformation? What physical formulas describe this transformation? (Fracture mechanics) give all the mechanical values

4) Superelasticity and Shape memory alloys. Describe the stress/strain curve, and the formula that describes it.

5) Stress shielding (description of the phenomena, why does it happen? What formula/physics describe it?

Medical Devices und europäische Klassen.

Unterschiede, Beispiele

Definition Sterilität, SAL. Welche Verfahren

gibt es. Genauer beschreiben Steam und

Dry Heat. Welche Materialien, Temperaturen,

Unterschiede, Probleme,

Was ist eine Keramik, Glass, Glasskeramik.

Bindungen, Struktur, Unterschiede,

Einsatzgebiete, Beispiele

Eigenschaften und Herstellung von LS2.

Bestandteile, Keimbildner, Rekristallisation

Phasenumwandlung von Zirkuniomoxid.

Zugaben, wie, wo und warum funktioniert

die Umwandlung

1 Prüfer der 5 Fragen stellt, man antwortet

direkt. Allgemein wird geholfen und die

Benotung ist sehr fair.

1: Definition of medical devices and categorization

2:Sterilization methods (listed) Gas sterilization in detail.

3:Covalent bonds, physical bonds

4: Properties of Polymers (Primary the differences in mechanical/thermal properties)

Just had my exam now, was okay they are really looking for buzzwords, which can be pretty annoying. To get an A(Sehr gut) you really have to know every single material and know stuff that wasn’t on the presentation slides but if you are not aiming for that a B(gut) isn’t too hard to achieve.

My questions:

Hydrogels—> materials, structure, DDS, what to use in combination with them (protection)

EMA—> classes of med devices, what makes a medDev class III

Ceramics—> Typ of ceramics, ways to change their properties, degradable ceramics is for bones….

Polymers—> types, differences, what happens when heated, solubility

Good luck to those following😉

Btw. Some people said you can choose between German and English, that’s not true for every exam, in my case it was only english.

I was asked about:

- Foreign Body Reaction

- Hydrogels

- Polymers (properties, types)

- Zirconia Strength Transformation

I think there was one more, but I forget.

1. Types of sterilization with more complex explanation of hot steam and irradiation.

2. Description of tensile test graph.

3. Zirconia, where used. Why has given properties. Difference between aluminum.

4. Polymer classification. elastic modulus/ temperature characteristic of each.

5. Nitinol Characteristics. Where used and tensile stress graph

Yes no need to worry

I Was asked about:

-MD classification

-Deformation in Metalls

-Ceramics and fracture mechanics

The formula and how to get tough ceramics

-toughening mechanism in zirconia oxides

-Nitinol alloys - stress/strain diagram

I was asked:

-Sterilization (especially EOl

-ceramics and then we went to ZrO2

-polymers types, diagrams

-acute system toxicity

-metals:Titanium, nitinol, ductility, mechanical properties,

I was asked: "definition of biomaterials, Implant, medical device

Classification of medical devices,

Definitions of: Stiffness, strength, hardness

Ceramics, glass & glass ceramics, Zirconia and it'ss phase transformation

I was asked about:

Foreign body reaction

Lithography

Hydrogels

Polymers

Titanium

1. Medical devices - groups and examples

2. Sterilization - definition, SAL, the overview how they are grouped, explain gas sterilization (I took EO as example), Example for a material you can sterilize with it (polymere)

3. Polymere - what is a Polymere?, different bonds that are involved, types of polymeres (thermpolasts, endoplasts, duroplasts) and their structure/bods/behaviour

4. Keramics - generall overview, describe Zirkoniumdoixid and how it is transformed

1. Classification of MDs and examples

2. What are Ceramics, inorganic glasses, glass ceramics?

3. Zirconia (explain transformation strengthening)

4. Give and explain the formula for fracture mechanics of ceramics. Where in this formula are the differences of materials? (in the critical K = K\_c) What are typical K\_c values for different materials?

5. What composites are used in dental fillings? (Ceramics + Monomers + Photoinitiators)

1. Classification of MDs and examples

2. Superelasticity

3. Polymerisation

4. Tensile Test and the important values

5. forgot

Mein Prüfer war Guillaume Olivier, war recht angenehm und hat sehr nett bewertet :)

Fragen waren (weiß nicht mehr alles aber naja)

- What is Genotoxicity and what tests you can use? (I told him I did not learn the tests, so he asked me about Pyrogen testing instead)

- From Pyrogen testing we switched to sterilisation methods

-- he asked how to determine how good sterilisation works -> SAL, and asked the definition of SAL

-- he asked for a viable sterilisation method for a material with metal + electronics + polymer (I choose Gas)

-- further explain one Gas sterilisation method

-- what is the problem with radiation sterilisation?

--- main chain scission

--- how to decrease main chain scission -> with vitamin E gas I think

- Explain Ceramics and Glass ceramics

-- why are ceramics used (what is so good about them)

-- name one ceramic

-- name one biocompatible ceramic

- strain stress curve and explain important points

- Do we use pure metals in biomechanics?

-- what is a good metal (i choose Ti)

--- what makes Ti so great

- When implanting a metal after a fracture, what can be problematic -> stress shielding